APPENDIX Q

Blue Ridge Alternative

BLUE RIDGE ALTERNATIVE

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1.0 INTRODUCTION

1.1 BACKGROUND

Pacific Connector Pipeline L.P. (Pacific Connector) originally filed an application for a Right-of Way Grant with the Bureau of Land Management (BLM) on April 17, 2006, pursuant to the Mineral Leasing Act (MLA) of 1920 and in accordance with Federal Regulations 43 CFR 2800 and 2880 to construct, operate, and maintain the Pacific Connector Gas Pipeline (PCGP) Project. In 2006, the PCGP Project was proposed as the natural gas sendout pipeline for the Jordan Cove Liquefied Natural Gas (LNG) import terminal proposed before the Federal Energy Regulatory Commission (FERC or Commission). On May 21, 2013, Jordan Cove Energy Project, L.P. (Jordan Cove) filed an application for its liquefaction and LNG export project with the FERC under Section 3 of the Natural Gas Act (NGA). Pacific Connector filed a companion application with the FERC for the supply pipeline to Jordan Cove's LNG terminal under Section 7 of the NGA on June 6, 2013. Under the MLA, BLM has the authority to issue a Right-of-Way Grant across all federal lands crossed by the project, including lands managed by the U.S. Forest Service (Forest Service) and the Bureau of Reclamation (Reclamation).

BLM has been, and continues to be, a Cooperating Agency with the FERC in preparing the Environmental Impact Statement (EIS) because of its jurisdictional responsibility to respond to Pacific Connector's application for a Right-of-Way Grant across federal lands managed by BLM, Forest Service, and Reclamation.

Based on comments to FERC on Pacific Connector's application related to a segment of the proposed route between milepost (MP) 11.1 R and 21.8, FERC requested that the applicant provide data comparing the proposed route with the route identified by commenters identified as the 2013 Blue Ridge Alternative Route. In response, the applicant supplemented the application to provide the information on the Blue Ridge Alternative Routes presented in section 3.4.2.2 of the EIS.

Based on the 2013 response to FERC's data request and inclusion of this information in the Draft EIS (DEIS), FERC requested the opinion of the BLM of whether or not the Blue Ridge Alternative Route was environmentally preferable to the proposed route. Subsequently, BLM responded that it would be unable to make that determination because "the preliminary information provided by the applicant regarding the Blue Ridge Route Alternative Route developed in response to the FERC data request was not sufficient in demonstrating that this alternative was environmentally preferable to BLM relative to the to the corresponding segment of the proposed route identified by Pacific Connector."

The 2014 DEIS provided a comparison of the Blue Ridge Alternative Route and the proposed route using information provided by Pacific Connector in its 2013 application. In essence, this detailed desktop analysis illustrated a number of attributes compared in a tabular format (e.g., length, construction disturbance, water bodies crossed, fish-bearing streams, etc.). On the basis of this comparison and other factors, FERC made a determination in the DEIS that the Blue Ridge Alternative Route provided "no significant environmental advantages over the proposed route."

While BLM and the Forest Service are cooperating agencies in FERC's National Environmental Policy Act (NEPA) process, both agencies have independent decisions that require compliance with their respective NEPA regulations, policies, and directives. Under BLM policy and regulatory standards, an alternative is brought forward for detailed analysis if it addresses a resource conflict or concern, or a scoping issue. The BLM and FERC developed this appendix specific to the Blue Ridge Alternative to enable BLM decision makers to determine compliance with the respective LMPs.

Substantive comments were submitted by a number of interested parties and stakeholders requesting that FERC reconsider and analyze a Blue Ridge Alternative similar to the one described in section 3.4.2.2 of the DEIS. With concurrence from the BLM and the Forest Service, FERC issued multiple data requests with the intent that this supplemental analysis to the Final EIS (FEIS) provides a detailed and specific comparison of the Blue Ridge Alternative relative to that segment of the proposed route described in the DEIS consistent with the requirements of the BLM and Forest Service by providing a detailed and specific comparison of the Blue Ridge Alternative relative to that segment of the proposed route described in the DEIS.

1.2 PURPOSE

The purpose of this appendix is to provide a comparison of the environmental consequences of the Blue Ridge Alternative (also referred to as Blue Ridge Route Variation) with the proposed route described in chapter 2 of the FEIS. This alternative was identified by Pacific Connector in their response to FERC's data request dated May 6, 2015. In this and subsequent filings, Pacific Connector provided the Blue Ridge Alternative, a route that was slightly modified from that identified in chapter 3 of the DEIS. These modifications were primarily related to adjustments based on site-specific field surveys and investigations.

This appendix acknowledges that a number of the resource discussions provided in the DEIS are not directly applicable to this alternative. While there are no National Forest System (NFS) lands at the location where this alternative occurs, as a cooperating agency with independent authority (i.e., LMP amendments, concurrence with Right-of-Way Grant), the Forest Service has a vested interest in ensuring that FERC's EIS is adequate for Forest Service decision-making and disclosure.

In its role as the decision-maker for the Right-of-Way Grant application, and to support amendments to its respective LMPs, BLM also requires that this appendix provide the information to support decisions subject to compliance with statutory and regulatory requirements.

1.3 TOPICS NOT REPEATED IN THIS APPENDIX

The following topics are not repeated in this appendix because the analysis does not change from the FEIS discussion or is not relevant for either the Blue Ridge Alternative or comparison portion of the proposed route:

- Coastal Zone Management
- Connectivity/Diversity Blocks on BLM Lands
- Soils-Compaction, Displacement/Mixing
- Mineral Resources
- Paleontological Resources
- Aquifers
- Water Supply Wells and Springs
- Public Supply Wells

- Other Groundwater Wells
- Springs and Seeps
- Oregon Water Quality Regulations and Standards
- Public Drinking Water Intakes
- Nationwide Rivers Inventory
- Peak Flows
- Contaminated Surface Water or Sediments
- State-Listed Threatened and Endangered Species
- Major Waterbody Crossings
- Socioeconomics
- Off-Highway Vehicle Use
- Air Quality and Noise
- Reliability and Safety

2.0 ROUTE DESCRIPTIONS

2.1 PROPOSED ROUTE – MP 11.3R TO 21.8

The segment of the current proposed route that is being compared to the Blue Ridge Alternative extends from about MP 11.29R to MP 21.77. From MP 11.29R, the proposed route heads southwest along the Coos River Valley to approximately MP 12.6R, where the route climbs moderately steep slopes. The route continues southward and at MP 9.6 follows a ridge top briefly before descending into Stock Slough at MP 10.05. After crossing Stock Slough, the route climbs up and over the nose of a ridge into East Catching Slough at MP 10.9. The route then ascends to a ridge at MP 12.6 and continues southeast and turns south at MP 12.8. From MP 12.8, the route continues south traversing moderate slopes within an existing Bonneville Power Administration (BPA) corridor. At approximately MP 14.2, the route reaches a ridge top and follows the ridgeline, descending at MP 15.5 steep slopes to Boone Creek. The route crosses Boone Creek and climbs again to a ridge crest at MP 16, continuing to MP 17.5 where the route climbs steep slopes to MP 17.8. From there, the route turns to the southeast and traverses variable terrain to the intersection with the Blue Ridge Alternative at MP 21.77 (MP 25.2 of the Blue Ridge Alternative).

The comparison portion of the proposed route would impact a total of approximately 229 acres during construction and 88 acres during operation (table 2.1-1). No temporary access roads would be built along this segment, though one permanent access road would be required. Two aboveground facilities, including mainline valve (MLV) #2 and the potential Blue Ridge communication site, would permanently affect 0.3 acre.

TABLE 2.1-1

Land Requirements for the Pacific Connector Pipeline Project – Proposed Route (Comparison)

Project Component	Length (miles) or Number of Sites a/	Land Affected During Construction (acres)	Land Affected During Operation (acres)
Pipeline Right-of-Way	14.4 miles b/	165.4	87.3 c/
Temporary Extra Work Areas	140 sites	62.0	(6.0) d/
Uncleared Storage Areas	4 sites	1.1	0
Rock Source & Disposal Sites	5 sites	(6.0) e/	(6.0) d/
Contractor and Pipe Storage Yards	0 sites	0	0
Existing Roads Needing Improvements	0 roads	0	0
Temporary Access Roads	0 roads	0	0
Permanent Access Roads	1 roads	0.1	0.1
Aboveground Facilities	2 sites	0.2 f/	0.3 f/
Hydrostatic Discharge Locations Outside Right-of-Way	0	0	0
Totals		**228.8**	**87.7**

a/ All miles and acres are rounded up to a tenth.
b/ Because of realignments, the length of the pipeline is different from the MPs which reflect the original 2007 route.
c/ 50-foot-wide permanent pipeline easement.
d/ Includes TEWAs, existing quarries, rock sources, and disposal areas that may be used as permanent storage areas. These areas would not be used during operation of the Project, and therefore are not included in the operational total.
e/ A total of 6.0 acres of rock source and disposal sites are accounted for as part of Temporary Extra Work Areas and are not double counted in the total construction acres.
f/ Construction impacts associated with the aboveground facility MLV#2 are included in the construction land requirement for the pipeline right-of-way except the potential Blue Ridge communication tower site which is approximately 0.2 acre.

2.2 BLUE RIDGE ALTERNATIVE

The Blue Ridge Alternative departs from the current proposed route at about MP 11.29R, and generally follows a higher elevation to the east of the proposed route. After MP 11.29R, the route continues south across the Coos River valley. It then continues into the Vogel Creek Valley and begins to climb the south valley wall at Alternative MP 12.1. From Alternative MP 12.1, the route ascends a moderately steep slope and reaches the ridge top at approximately MP 12.2, and follows a ridgeline for approximately 2.2 miles. From Alternative MP 14.7, the route follows Laxstrom Gulch into Stock Slough. From about Alternative MP 15.3, the route climbs steep north-facing slopes on the south valley wall of Stock Slough, and reaches the ridge top at Alternative MP 15.5. The route continues along a ridge heading southeast or south to Alternative MP 19.6, where the route climbs steep slopes to the top of "Blue Ridge" at MP Alternative 19.9. From the top of Blue Ridge, the route continues southward and descends the nose of Blue Ridge down to Evans Creek. After crossing Evans Creek, the route ascends again to a ridge top at Alternative MP 24.6, following the ridge to the intersection with the proposed route at Alternative MP 25.2 (MP 21.77 on the proposed route). Alignment sheets for the Blue Ridge Alternative are included in Attachment 1 to this appendix.

The Blue Ridge Alternative would impact a total of approximately 244 acres during construction, and 85 acres during operation (table 2.2-1). No temporary or permanent access roads would be built as part of the alternative. Two aboveground facilities, including MLV#2 (at a different location than for the proposed route) and the potential Blue Ridge communication site would permanently affect 0.3 acre.

TABLE 2.2-1

Land Requirements for the Pacific Connector Pipeline Project – Blue Ridge Alternative

Project Component	**Length (miles) or Number of Sites a/**	**Land Affected During Construction (acres)**	**Land Affected During Operation (acres)**
Pipeline Right-of-Way	14.0 miles b/	161.4	85.0 c/
Temporary Extra Work Areas	95 sites	37.0	0
Uncleared Storage Areas	42 sites	45.4	0
Rock Source & Disposal Sites	0 sites	0	0
Contractor and Pipe Storage Yards	0 sites	0	0
Existing Roads Needing Improvements	0 roads	0	(0)
Temporary Access Roads	0 roads	0	0
Permanent Access Roads	0 roads	0	0
Aboveground Facilities	2 sites	0.2 d/	0.3 d/
Hydrostatic Discharge Locations Outside Right-of-Way	0	0	0
Totals		**244**	**85.3**

a/ All miles and acres are rounded up to a tenth.
b/ Because of realignments, the length of the pipeline is different from the MPs which reflect the original 2007 route.
c/ 50-foot-wide operational pipeline easement.
d/ Construction impacts associated with the aboveground facility MLV #2 are included in the construction land requirement for the pipeline right-of-way except the potential Blue Ridge communication tower site which is approximately 0.2 acre.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 LAND USE

3.1.1 Land Ownership

The comparison portion of the proposed route is located primarily on private land (12.9 miles, 89.8 percent) while the Blue Ridge Alternative is more evenly split between private land (6.5 miles, 46.1 percent) and federal BLM land (7.5 miles, 53.9 percent) (table 3.1.1-1). The Blue Ridge Alternative does not cross any state land, and the comparison portion of the proposed route crosses less than 0.1 mile (table 3.1.1-1). Neither route would cross tribal land.

TABLE 3.1.1-1

Land Ownership Crossed by the Pacific Connector Pipeline, By Alternative

		Federal Land		State Land		Private Land		
	County	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Total**
Proposed Route (Comparison)	Coos	1.4	9.9	<0.1	0.3	12.9	89.8	**14.4**
Blue Ridge Alternative	Coos	7.5	53.9	-	-	6.5	46.1	**14.0**

Note: Rows and columns may not add correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").

3.1.2 Existing Land Use and Zoning

3.1.2.1 Land Use

Pipeline

Most of the pipeline route would cross forested land for both the Blue Ridge Alternative and the comparison portion of the proposed route, totaling 11.4 miles (81.5 percent) and 11 miles (76.6 percent), respectively (table 3.1.2.1-1). The Blue Ridge Alternative would cross slightly less agricultural land: 1.5 miles compared to 2.1 miles for the proposed route. Both routes would also cross short distances of transportation/communication lands and water (stream crossings). Only the comparison portion of the proposed route would cross wetlands (0.1 mile) or residential lands (0.1 mile).

Tables 3.1.2.1-2a and 3.1.2.1-2b indicate the acres of land affected by construction and operation of the comparison portion of the proposed route and the Blue Ridge Alternative. The proposed route comparison portion would affect a total of 229 acres during construction, including 165 acres of forest land, 43 acres of cropland/pastureland, 17 acres of transportation/ communication land, 2 acres of streams, 1 acre of residential land, and less than 1 acre each of industrial, rangeland, ditches/canals, and wetland areas (table 3.1.2.1-2a). The Blue Ridge Alternative would impact a slightly larger area, totaling 244 acres. This would include 203 acres of forest land, 24 acres of cropland/pastureland, 17 acres of transportation/communication land, and less than 1 acre each of residential, commercial, stream, and wetland areas (table 3.1.2.1-2b).

TABLE 3.1.2.1-1

Land Uses Crossed by the Pacific Connector Pipeline, by Alternative

U.S. Geological Survey Land Use Classification			Proposed Route (Comparison) Total Miles	Proposed Route (Comparison) Percent of Total	Blue Ridge Alternative Total Miles	Blue Ridge Alternative Percent of Total
Urban or Built-Up Land	Residential		0.1	0.5	-	-
	Commercial		-	-	-	-
	Industrial		-	-	-	-
	Transportation/Communication		0.9	6.3	1.1	7.7
	Other Urban or Built-up Land		-	-	-	-
		Subtotal	**1.0**	**6.8**	**1.1**	**7.7**
Agricultural Lands	Cropland and Pasture		2.1	14.9	1.5	10.8
	Orchards, Groves, Vineyards, etc.		0.0	0.0	0.0	0.0
		Subtotal	**2.1**	**14.9**	**1.5**	**10.8**
Rangeland	Herbaceous Rangeland		-	-	-	-
	Shrub and Brush Rangeland		-	-	-	-
	Mixed Rangeland		-	-	-	-
		Subtotal	**0.0**	**0.0**	**0.0**	**0.0**
Forest Land	Deciduous Forest Land		-	-	-	-
	Evergreen Forest Land		1.5	10.6	0.8	5.5
	Clearcut Forest Land		0.9	6.3	0.3	2.0
	Regenerating Forest Land		6.0	41.9	5.2	37.3
	Mixed Forest Land		2.6	17.8	5.1	36.7
		Subtotal	**11.0**	**76.6**	**11.4**	**81.5**
Water	Streams		0.1	1.0	<0.1	0.1
	Ditches and Canals		-	0.1	-	-
	Bays and Estuaries		-	-	-	-
		Subtotal	**0.2**	**1.0**	**<0.1**	**0.1**
Wetlands	Forested Wetland		0.1	0.6	-	-
	Nonforested Wetland		-	0.1	-	-
		Subtotal	**0.1**	**0.6**	**0.0**	**0.0**
Barren Land	Beaches		-	-	-	-
	Mines, Quarries, Gravel Pits		-	-	-	-
		Subtotal	**0.0**	**0.0**	**0.0**	**0.0**
		Project Total	**14.4**	**100.0**	**14.0**	**100.0**

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").

TABLE 3.1.2.1-2a

Acres of Land Affected by Construction and Operation of the Pacific Connector Pipeline – Proposed Route (Comparison)

	Residential	Commercial	Industrial	Transportation/ Communication	Other Urban/Built-up Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest	Streams	Ditches/Canals	Bays and Estuaries	Forested Wetlands a/	Nonforested Wetlands a/	Beaches	Strip Mines, Quarries, Gravel Pits	Total
CONSTRUCTION DISTURBANCE b/																							
Construction Right-of-Way	<1	-	-	9	-	25	-	-	-	-	-	17	31	10	70	2	<1	-	<1	<1	-	-	165
Hydrostatic Discharge Sites	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Klamath CS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Temporary Extra Work Areas	<1	0	<1	8	-	18	-	<1	-	-	-	3	6	3	24	<1	<1	-	-	<1	-	-	62
Uncleared Storage Areas	-	-	-	<1	-	<1	-	-	-	-	-	-	1	<1	-	-	-	-	-	-	-	-	1
Rock Source/Disposal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contractor and Pipe Storage Yards	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Access Roads (TARs/PARs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	1	0	<1	17	0	43	0	<1	0	0	0	20	38	13	94	2	<1	0	<1	<1	0	0	**229**
OPERATION DISTURBANCE																							
Permanent Easement c/	<1	-	-	5	-	13	-	-	-	-	-	9	16	5	37	<1	<1	-	<1	<1	-	-	88
Permanent Access Roads	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	<1	0	0	5	0	13	0	0	0	0	0	9	16	5	37	<1	<1	0	<1	<1	0	0	**88**
30-Foot Maintenance Corridor	<1	-	-	3	-	8	-	-	-	-	-	6	9	3	22	<1	<1	-	<1	<1	-	-	52

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown a "<1").

a/ Acres of wetlands affected according to jurisdictional delineation is greater than the acreage shown based on the land use definition used in this table. See section 3.4.3 for discussion of impacts to wetlands.

b/ Construction disturbance associated with the aboveground facilities is included in the pipeline construction right-of-way impacts. Operation disturbance for aboveground facilities is presented separately in table 3.1-4a. Because disturbance from aboveground facilities is only 0.3 acre, total operation disturbance remains 88 acres.

c/ The permanent easement is located within the disturbed acreage of the construction right-of-way on non-federal lands. Only operational easements would be available on BLM lands. It is not an addition to the construction impacts.

TABLE 3.1.2.1-2b

Acres of Land Affected by Construction and Operation of the Pacific Connector Pipeline - Blue Ridge Alternative

	Residential	Commercial	Industrial	Transportation/ Communication	Other Urban/Built-up Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest	Streams	Ditches/Canals	Bays and Estuaries	Forested Wetlands a/	Nonforested Wetlands a/	Beaches	Strip Mines, Quarries, Gravel Pits	Total
CONSTRUCTION DISTURBANCE b/																							
Construction Right-of-Way	-	-	-	13	-	18	-	-	-	-	-	9	59	3	59	<1	-	-	-	<1	-	-	161
Hydrostatic Discharge Sites	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Klamath CS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Temporary Extra Work Areas	<1	<1	-	3	-	6	-	-	-	-	-	1	13	2	12	<1	-	-	-	<1	-	-	37
Uncleared Storage Areas	-	-	-	1	-	<1	-	-	-	-	-	1	19	<1	-	-	-	-	-	<1	-	-	45
Rock Source/Disposal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contractor and Pipe Storage Yards	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Access Roads (TARs/PARs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**<1**	**<1**	**0**	**17**	**0**	**24**	**0**	**0**	**0**	**0**	**0**	**11**	**92**	**5**	**95**	**<1**	**0**	**0**	**0**	**<1**	**0**	**0**	**244**
OPERATION DISTURBANCE																							
Permanent Easement c/	-	-	-	7	-	9	-	-	-	-	-	5	31	2	32	<1	-	-	-	<1	-	-	85
Permanent Access Roads	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**0**	**0**	**0**	**7**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**5**	**31**	**2**	**32**	**<1**	**0**	**0**	**0**	**<1**	**0**	**0**	**85**
30-Foot Maintenance Corridor	-	-	-	4	-	6	-	-	-	-	-	3	19	<1	19	<1	-	-	-	<1	-	-	51

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown a "<1").

a/ Acres of wetlands affected according to jurisdictional delineation is greater than the acreage shown based on the land use definition used in this table. See section 3.4.3 for discussion of impacts to wetlands.

b/ Construction disturbance associated with the aboveground facilities is included in the pipeline construction right-of-way impacts. Operation disturbance for aboveground facilities is presented separately in table 3.1-4b. Because disturbance from aboveground facilities is only 0.3 acre, total operation disturbance remains 85 acres.

c/ The permanent easement is located within the disturbed acreage of the construction right-of-way on non-federal lands. Only operational easements would be available on BLM lands. It is not an addition to the construction impacts.

Aboveground Facilities

The aboveground facilities associated with the comparison portion of the proposed route and the Blue Ridge Alternative would impact a total of less than one acre. The MLV #2 site for the proposed route would be located on forested land, and the MLV #2 site for the Blue Ridge Alternative would be located in a cropland pasture/wetland area (table 3.1.2.1-3). The potential communication tower at Blue Ridge would be located on an existing utility site for both routes.

TABLE 3.1.2.1-3

Acres Affected by Operation of Pacific Connector Proposed Aboveground Facilities – Proposed Route (Comparison)

Facility	Milepost	Land Use	Acres
Proposed Route (Comparison)			
MLV #2 (Boone Creek Road)	15.69	Mixed Forest Land	<1
		Subtotal	**<1**
Communication Sites Not Located at Other Aboveground Facilities			
Blue Ridge a/	~ 20	Transportation, Communications, and Utilities/Commercial	<1
		Subtotal	<1
		Total	**<1**
Blue Ridge Alternative			
MLV #2 (Stock Slough Rd #54)	15.08	Cropland Pasture/Emergent Wetland	<1
		Subtotal	**<1**
Communication Sites Not Located at Other Aboveground Facilities			
Blue Ridge a/	~ 20	Transportation, Communications, and Utilities/Commercial	<1
		Subtotal	**<1**
		Total	**<1**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Communication facilities would utilize existing towers and equipment buildings, where space is available for lease, with no associated disturbance. If construction of new facilities is required, Pacific Connector would obtain an approximate 100-foot x 100-foot (0.23-acre) area in the immediate area of the existing communication tower facilities.

3.1.2.2 Zoning

Both the comparison portion of the proposed route and Blue Ridge Alternative primarily cross Coos County land zoned for Forest use (10.8 and 13.1 miles, respectively). The Blue Ridge Alternative crosses less land zoned for Exclusive Farm Use (0.8 mile versus 2.6 miles for the proposed route). The comparison portion of the proposed route would cross 0.8 mile of land zoned as part of the Coos Bay Estuary Management Plan (CBEMP), compared to 0.1 mile for the Blue Ridge Alternative. The proposed route would also cross 0.2 mile of land zoned Rural Residential (table 3.1.2.2-1).

TABLE 3.1.2.2-1

County Zones Crossed by the Pacific Connector Pipeline Project, By Alternative (Miles)

County	Zone	Proposed Route (Comparison)	Blue Ridge Alternative
Coos County	Forest (F)	10.8	13.1
	Exclusive Farm Use (EFU)	2.6	0.8
	CBEMP (all zones)	0.8	0.1
	Rural Residential (RR-5, RR-2)	0.2	0.0
	Industrial (IND)	0.0	0.0
	Total	**14.4**	**14.0**

Note: Miles are rounded to the nearest tenth of a mile.

3.1.2.3 Existing Residences, Commercial Buildings and Planned Developments

Existing Residences

There are no residences within 50 feet of the Blue Ridge Alternative, while there is one residence (MP 14.2) within 50 feet of the comparison portion of the proposed route. Pacific Connector developed site-specific drawings for residences within 50 feet of Project construction activity, included in appendix I of the FEIS.

Planned Development

Based on Pacific Connector's communication with the Coos County Planning Department, as of July 10, 2015, the only development in the vicinity of the Blue Ridge Alternative (within 0.25 mile) is an update to an existing cellular tower. There are no known developments within 0.25 mile of the comparison portion of the proposed route. However, concerns have been expressed by private landowners along the comparison portion of the proposed route regarding potential future limitations for future development on their properties. Impacts to private property are discussed in section 4.9 of the EIS, and the socioeconomic analysis is not repeated in this appendix.

3.1.3 Land Use for Pacific Connector Components on BLM Lands

The comparison portion of the proposed route would cross 1.4 miles and affect 20 acres of BLM land within the Coos Bay District (table 3.1.3-1), nearly all of which would be forest land (19 acres), with the remainder affecting transportation/communication land, industrial land, and streams (table 3.1.3-2a). The Blue Ridge Alternative would cross 7.5 miles of BLM land also within the Coos Bay District, affecting a total of 130 acres during construction (table 3.1.3-1), 118 acres of which would be on forest land, 12 acres on transportation/communication land, and less than one acre each of commercial, streams, and wetlands (table 3.1.3-2b).

TABLE 3.1.3-1

BLM Lands Affected by the Pacific Connector Pipeline Project – By Alternative

Pipeline Facility/Component	Proposed Route (Comparison)	Blue Ridge Alternative
Miles Crossed by Pipeline	1.4	7.5
Temporary Construction Acreage Requirements (acres)		
Construction Right-of-Way	15.5	86.4
TEWAs	4.1	16.2
UCSAs	0.0	27.5
Off-site Source/Disposal	0	0
Existing Roads Needing Improvements in Limited Locations	0	0
Temporary Access Roads (TAR)	0	0
Hydrostatic Discharge Locations Outside the right-of-way	0	0
Total Temporary Impacts (acres)	**19.6**	**130.1**
Operational Construction Acreage Requirements (acres)		
Operational Easement	8.6	45.7
Permanent Access Roads (PAR)	0	0
Aboveground Facilities	<1	<1
Total Operational Impacts (acres)	**8.6**	**45.7**
Right-of-Way (acres)		
30-Foot Maintained Right-of-way (acres)	5.2	27.4

Note: Columns may not sum correctly due to rounding. Miles rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1"). Acres rounded to the nearest whole acre (values less than 1 shown as "<1").

TABLE 3.1.3-2a

BLM Lands Required for Construction and Operation of the Pacific Connector Pipeline by Land Use Type (acres) – Proposed Route (Comparison)

Jurisdiction/ Project Element	Residential	Commercial	Industrial	Transportation/ Communication	Other Urban/Built-up Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest Land	Streams	Ditches	Bays and Estuaries	Forested Wetlands	Nonforested Wetlands	Beaches	Strip Mines, Quarries, Gravel Pits	Transitional Areas	Total
Coos Bay BLM																								
Construction	-	-	<1	1	-	-	-	-	-	-	-	14	2	-	3	<1	-	-	-	-	-	-	-	20
Aboveground Facilities Outside the ROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Operational Easement a/	-	-	-	<1	-	-	-	-	-	-	-	6	<1		2	<1	-	-	-	-	-	-	-	9
Permanent Access Roads	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Foot Maintenance Corridor	-	-	-	<1	-	-	-	-	-	-	-	4	<1		<1	<1	-	-	-	-	-	-	-	5

Note: Rows may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1".

a/ The operational easement is located within the disturbed acreage of the construction right-of-way. It is not an addition to the construction impacts.

TABLE 3.1.3-2b

BLM Lands Required for Construction and Operation of the Pacific Connector Pipeline by Land Use Type (acres) – Blue Ridge Alternative

Jurisdiction/ Project Element	Residential	Commercial	Industrial	Transportation/ Communication	Other Urban/Built-up Land	Cropland/Pastureland	Orchards, Groves, Vineyards, Nurseries	Herbaceous Rangeland	Shrub/Brush Rangeland	Mixed Rangeland	Deciduous Forest Land	Evergreen Forest Land	Mixed Forest Land	Clearcut Forest Land	Regenerating Forest Land	Streams	Ditches	Bays and Estuaries	Forested Wetlands	Nonforested Wetlands	Beaches	Strip Mines, Quarries, Gravel Pits	Transitional Areas	Total
Coos Bay BLM																								
Construction	-	<1	-	12	-	-	-	-	-	-	-	6	67	3	42	<1	-	-	-	<1	-	-	-	130
Aboveground Facilities Outside the ROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Operational Easement a/	-	-	-	5	-	-	-	-	-	-	-	3	23	<1	14	<1	-	-	-	-	-	-	-	46
Permanent Access Roads	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Foot Maintenance Corridor	-	-	-	3	-	-	-	-	-	-	-	2	14	<1	8	<1	-	-	-	-	-	-	-	27

Note: Rows may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1".

a/ The operational easement is located within the disturbed acreage of the construction right-of-way. It is not an addition to the construction impacts.

Neither route would cross Oregon and California (O&C) lands, while the comparison portion of the proposed route would cross 1.4 miles of Coos Bay Wagon Road Lands and the Blue Ridge Alternative would cross 1.4 miles of Reserved Public Domain lands (table 3.1.3-3). The Blue Ridge Alternative would cross 7.2 miles of Matrix lands, 0.9 mile of Riparian Reserves (17.4 acres), and 0.4 mile of unmapped Late Successional Reserves (LSRs) (10.5 acres). As part of Pacific Connector's survey efforts to date, additional land has been identified that may potentially be delineated by BLM as unmapped LSR. BLM wildlife biologists have reviewed the survey data and determined MAMU occupancy was observed in six of the areas that were surveyed. Wildlife biologists from the Coos Bay District are in the process of delineating occupied stands as a result of the surveys. Delineation of these stands could increase unmapped LSRs crossed by approximately 1.4 miles, which would reduce Matrix lands crossed by approximately 1.4 miles (table 3.1.3-4; see also section 3.1.4.4 below).

TABLE 3.1.3-3

O&C Lands, Coos Bay Wagon Road Lands, and Reserved Public Domain Lands Crossed by the Pacific Connector Pipeline (miles), By Alternative

Alternative	O&C Lands	Coos Bay Wagon Road Lands	Reserved Public Domain Lands a/	Total
Proposed Route (Comparison)	-	1.4	-	**1.4**
Blue Ridge Alternative	-	-	1.4	**0.6**

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").
a/ Reserved Public Domain Lands are the remaining lands not classified as O&C or Coos Bay Wagon Road lands.

TABLE 3.1.3-4

BLM LMP Land Allocations Crossed by the Pacific Connector Pipeline Project (miles) – Proposed Route (Blue Ridge Comparison Area)

Alternative	LSRs	Unmapped LSRs	Matrix	Riparian Reserves a/
Proposed Route (Comparison)	-	-	1.4	1.0
Blue Ridge Alternative	-	0.4	7.2	0.9

Note: Rows and columns may not sum correctly due to rounding. Miles are rounded to the nearest tenth of a mile (values below 0.1 are shown as "<0.1").
a/ Riparian Reserves overlay other land use allocations.
Note: Unmapped LSRs only include known MAMU occupied stands that have been delineated by the Coos Bay DIstrict and do not include 6 additional areas on Matrix lands where Pacific Connector's survey efforts (to date) show observed occupied behavior. Wildlife biologists from the Coos Bay District are in the process of delineating occupied stands as a result of the surveys. Delineation of these stands could increase Unmapped LSRs crossed by approximately 1.4 miles, which would reduce Matrix lands crossed by approximately 1.4 miles.

3.1.4 BLM Resource Management Plans

All BLM lands associated with the Blue Ridge route are managed by the Coos Bay District under the Coos Bay District Resource Management Plan (RMP). The management direction for lands within the Blue Ridge area includes three land allocations; LSR (including unmapped LSRs), Riparian Reserve and matrix. A discussion of the BLM RMPs and management direction including the Northwest Forest Plan (NWFP) is included in section 4.1.3.3 of the FEIS. Appendix E of the EIS provides a comprehensive description of the management direction applicable to the PCGP

Project on lands managed by the Coos Bay District, including those associated with the Blue Ridge Alternative.

3.1.4.1 Proposed Amendments to BLM Land Management Plans

This section describes three proposed RMP amendments that would apply to the Blue Ridge Alternative on the BLM Coos Bay District. Two of these amendments relate to impacts and mitigations associated with the LSR network and one relates to the Survey and Manage (S&M) species mitigation requirements in the NWFP.

BLM/FS-1[1] : Site-Specific Waiver of Management Recommendations for Survey and Manage Species in the BLM Coos Bay District, Roseburg District, Medford District, and Klamath Falls Resource Area of the Lakeview District RMPs, and the Umpqua National Forest, Rogue River National Forest, and Winema National Forest LRMPs

Applicable BLM District RMPs and National Forest LRMPs would be amended to exempt certain known sites within the area of the proposed Pacific Connector Right-of-Way Grant from the management recommendations required by the 2001 "Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines,". For known sites within the proposed right-of-way that cannot be avoided, the management recommendations for protection of known sites of Survey and Manage species would not apply. For known sites located outside the proposed right-of-way but with an overlapping protection buffer, only that part of the buffer within the right-of-way would be exempt from the protection requirements of the management recommendations. Those management recommendations would remain in effect for that part of the protection buffer that is outside of the right-of-way.

The impacts to S&M species along the Blue Ridge Alternative are discussed in section 3.7.3 below and in the Blue Ridge Alternative Supplement in appendix K of the FEIS.

Coos Bay District, BLM-1: Site-Specific Exemption of Requirement to Protect MAMU Habitat on the BLM Coos Bay District

The Coos Bay District RMP would be amended to waive the requirements to protect contiguous existing and recruitment habitat for MAMU within the Pacific Connector right-of-way that is within 0.5 mile of occupied MAMU sites, as mapped by the BLM. This is a site-specific amendment applicable only to the Pacific Connector right-of-way and would not change future management direction at any other location.

In the Coos Bay District, occupied contiguous existing and recruitment MAMU habitat is part of the LSR network. Waiving the requirement to protect contiguous existing and recruitment habitat for MAMU within the Project right-of-way on the Coos Bay District would result in both direct and indirect impacts on mapped and unmapped elements of the LSR network. The analysis of

[1] The numbering of the proposed LMP amendments corresponds to the designations used in the NOI for the Pacific Connector Pipeline Project published by the BLM and Forest Service in the *Federal Register* on September 21, 2012 (Vol. 77, No. 184).

impacts and mitigations associated with the LSR network on the Blue Ridge Alternative is discussed in section 3.1.4.4 below.

Coos Bay District, BLM-4: Reallocation of Matrix Lands to LSR

> *The Coos Bay District RMP would be amended to change the designation of approximately 387*[2] *acres from the Matrix land allocation to the LSR land allocation in Sections 19 and 29 of T. 28 S., R. 10 W., W. M., Oregon. This change in land allocation is proposed to mitigate for the potential adverse impact of the Pacific Connector Pipeline Project on LSRs in the Coos Bay District. The proposed amendment would change future management direction for the lands reallocated from Matrix lands to LSR.*

Reallocation of O&C or Coos Bay Wagon Road matrix lands to LSR potentially affects the sustained timber yield objective for the O&C and Coos Bay Wagon Road lands. In order to ensure that this objective is met, the BLM is requiring the applicant to acquire 387 acres of comparable lands to be transferred to the BLM to be managed as matrix lands that contribute to the sustained timber yield objectives of the O&C and Coos Bay Wagon Road lands. A discussion of this proposed amendment as it relates to the Blue Ridge Route Alternative is in section 3.1.4.4 below.

3.1.4.2 Resource Values and Conditions on Federal Land: ACS

In general, section 4.1.3.5 of the EIS provides an adequate discussion of the resource values and conditions on federal lands as they relate to the nine ACS objectives. Additional information is also provided in appendix J, as supplemented to address the Blue Ridge Alternative.

Summary of Environmental Consequences Related to ACS

Four fifth-field watersheds would be affected by either the proposed route or the Blue Ridge Alternative: Coos Bay-Frontal, North Fork Coquille River, Coquille River and South Fork Coos River. As proposed, all of the design features, including those described in the Plan of Development (POD) submitted by the applicant would apply to all aspects of both the proposed route and the Blue Ridge Alternative on federal lands. These are fully described in chapter 2 of the FEIS. Section 4.1 of the FEIS includes a discussion of the environmental consequences of the PCGP Project. In general, that discussion is also applicable to the BLM lands included in the Blue Ridge Alternative and discussed in this appendix. In addition, appendix J in the DEIS provides a comprehensive discussion of the watershed conditions and environmental impacts for three of these watersheds; Coos Bay-Frontal and North Fork Coquille River and Coquille River specific to ACS objectives. The South Fork Coos River was not included in that version of appendix J. For the FEIS, appendix J has been revised to include three supplemental attachments that are specific to the Blue Ridge Route Alternative for each of these watersheds. These attachments provide the supporting documentation of the analysis presented in the following sections.

The following elements are fully addressed in section 4.1.3.5 of the FEIS and appendix J and excluded from detailed discussion in this appendix.

[2] The NOI published in the *Federal Register* listed 454 acres for BLM-4. The change (67 acres) reflects the discovery of an occupied MAMU stand within the proposed Matrix reallocation area. These 67 acres are now unmapped LSR; therefore, the net matrix area has been reduced to 387 acres.

- Sediment
  - Corridor clearing and construction
  - Stream channel crossing
  - Post-construction
- Streambed and Stream Bank Impacts
- Temperature
- Temporary Construction Corridor
- Pipeline Easement
- Hydrostatic Testing
- Use and Maintenance of Roads

Compliance with Standards and Guidelines

Appendix E of the EIS has been reviewed as it relates to consistency of the Blue Ridge Alternative with BLM's Coos Bay District LMP. As revised in the FEIS, appendix E documents consistency of the Blue Ridge Alternative, including consideration of the specific amendments to the Coos Bay District LMP discussed previously.

Determining Consistency with the ACS

The entire segment of the Blue Ridge Alternative falls within the Oregon Coast Range Province. A comprehensive discussion of this province as it related to ACS objectives is provided in chapter 2 of appendix J to the FEIS and is directly applicable to this route alternative and is not discussed further in this document.

3.1.4.3 Riparian Reserves

As described previously, the Blue Ridge Alternative would affect three fifth-field watersheds; two of these—Coos Bay-Frontal and North Fork Coquille River—would also be affected by the proposed route. Within each of these watersheds, BLM manages Riparian Reserves consistent with the requirements of the ACS as outlined in the Coos Bay District LMP. While the Forest Service manages Riparian Reserves in the Coos Bay-Frontal watershed, neither the proposed route nor the Blue Ridge Alternative would affect NFS lands. Table 3.1.4.3-1 provides a summary of the Riparian Reserves for each of these watersheds, including the respective subwatersheds.

TABLE 3.1.4.3-1

Land Management (acres) and Federal Land Allocations (acres) Along the Blue Ridge Alignment

		Land Management (acres)		Land Allocations (acres)	
				Riparian Reserves	
Fifth-Field Watershed	Total (acres)	BLM	NFS	BLM	NFS
Coos Bay- Frontal Pacific Ocean (Total)	**151,608**	**5,409**	**4,914**	**2,056**	**2,556**
Big Creek	16,945	73			
Catching Slough	16,837	3,092		1,608	
Coos Bay	38,812	825	668		348
Coos River	4,539	430		254	
Haynes Inlet	26,401	0	389		202
Isthmus Slough	21,623	60		24	
North Spit	6,815	929	3,857		2,006
Winchester Slough	19,636	0		170	
North Fork Coquille River (Total)	**98,404**	**36,852**		**19,275**	
Hudson Creek	23,018	7,814		3,825	
Johns Creek	18,779	3,171		1,857	
Middle Creek	32,467	19,399		9,939	
Moon Creek	24,140	6,468		3,654	
Coquille River (Total)	**111,645**	**2,737**		**1,095**	
Bear Creek	15,422	0			
Beaver Slough	13,314	430		172	
Coquille River Estuary	18,349	0			
Cunningham Creek	21,354	2,050		820	
Hall Creek	24,077	257		103	
Lampa Creek	19,129	0			
South Fork Coos River (Total)	**160,144**	**32,639**		**17,191**	
Bottom Creek	11,400	446		152	
Cedar Creek-Williams River	34,809	3,477		1,731	
Daniels Creek-South Fork Coos River	25,484	4,017		2,215	
Fall Creek	9,867	0		0	
Tioga Creek	24,605	15,766		8,467	
Williams River-South Fork Coos River	26,549	7,218		3,765	
Wilson Creek-Williams River	27,430	1,715		861	

As table 3.1.4.3-1 indicates, the proportion of Riparian Reserves within these four fifth-field watersheds varies between about 38 and 52 percent of federal lands, in part due to ownership patterns but also as a result of underlying landforms. Table 3.1.4.3-2 compares the impacts to Riparian Reserves between the proposed route and the Blue Ridge Alternative by fifth-field watershed. Impacts to Riparian Reserves include areas where the actual waterbody that forms the basis for this land allocation (e.g., Steinnon Creek) is impacted as well as those areas that essentially clip the Riparian Reserve. A clip occurs when the polygon that entails the Riparian Reserve land allocation is intersected by some aspect of the route; not an actual waterbody crossing. The comparison of impacts to Riparian Reserves between the proposed route and the Blue Ridge Alternative illustrates that under either alternative, the overall impacts to Riparian Reserves within each fifth-field watershed would equate to less than one percent of the total area of Riparian Reserve managed by BLM in these watersheds.

TABLE 3.1.4.3-2

Riparian Reserves Impacted by the Proposed Route and Blue Ridge Alternative on BLM Lands

Alternative	Watershed (Name)	Number of Riparian Reserves Impacted	Approximate Acres Impacted	Watershed Analysis Completed
Proposed Route (Comparison)	Coos Bay Frontal	2	2.9	2010
	Coquille River	1	1.2	1997
	North Fork Coquille River	4	10.4	2001
Total Riparian Reserves Impacted on BLM Lands		**7**	**14.1**	
Blue Ridge Alternative	Coos Bay Frontal	12	9.4	2010
	South Fork Coos River	7	3.3	2001
	North Fork Coquille River	3	4.7	1997
Total Riparian Reserves Impacted on BLM Lands		**22**	**17.4**	

Note that acres may not sum correctly due to rounding. Acres are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1.
Source: BLM 2006

Project Impacts by ACS Objectives

Water Temperature Impacts

To support an evaluation of consistency with ACS objectives, BLM and the Forest Service directed North State Resources, Inc. (NSR) to prepare site-specific water temperature impacts assessments for perennial streams on BLM and NFS lands subject to impacts from the proposed route (NSR 2015a,b)[3]. Subsequently, in order to assess ACS consistency for the Blue Ridge Alternative, NSR prepared an additional site-specific assessment for the Steinnon Creek crossing at MP 20.25 in the North Fork Coquille River watershed.

The Steinnon Creek temperature assessment was conducted similar to those performed for other perennial stream crossings on the Coos Bay District. BLM hydrologists provided NSR with current information on baseline conditions with respect to stream temperature, streamflow, shade and air temperature adequate to develop and run the temperature models (SSTEMP and Brown) used to analyze impacts to Steinnon Creek. A full discussion of this assessment is provided in Attachment 2 to this appendix.

A key distinction between the two models used in this assessment is that the Brown model is only relevant for complete shade removal; SSTEMP does provide for modeling of effective shade. Results of the SSTEMP and Brown modeling indicate that with 0 percent effective shade retention (construction impacts with no mitigation), the modeled 7-day moving average (7DMA) maximum stream temperature increase of 0.4°F–0.5°F (0.2°C–0.3°C) at the Steinnon Creek crossing would exceed the Antidegradation Policy threshold of 0.25°F (0.14°C). However, the expected change in the 7DMA maximum stream temperature does not exceed the threshold of 0.5°F (0.3°C), the criteria necessary to meet the State of Oregon policy to protect cold water (PCW).

[3] NSR. 2015a. Pacific Connector Gas Pipeline Project – Technical Memorandum for Water Temperature Impact Assessment. Prepared for USDI Bureau of Land Management. January 2015. North State Resources, Redding, CA. NSR. 2015b. Pacific Connector Gas Pipeline Project – Technical Memorandum for Water Temperature Impact Assessment. Prepared for USDA Forest Service.. January 2015. North State Resources, Redding, CA.

The SSTEMP model was used to predict the expected change in the 7DMA stream temperature at the Steinnon Creek crossing with different shade levels. With 50 percent effective shade established after disturbance, the 7DMA stream temperature is expected to increase 0.2°F (0.1°C). Both the PCW criteria and the Antidegradation Policy threshold would be met under these conditions. With 75 percent effective shade established at the Steinnon Creek crossing, there are very minimal impacts to the stream temperature (0.1°F [0.06°C]) and both the PCW criteria and the Antidegradation Policy threshold would be met.

Based on these modeling results, at least 50 percent effective shade needs to be attained at the hydrofeature to meet ACS objectives as well as ODEQ temperature standards. Mitigation measures that would quickly reestablish 50 percent effective shade can easily be achieved and possibly surpassed by placement of large wood/boulders, planting larger conifers, and planting lush riparian vegetation such as salal, salmonberry, and sword fern. The assessment documents that there is an abundant source of small wood, shading the creek and trapping substrate, at the crossing site. Compliance with the site-specific requirements to place large woody debris (LWD) post-construction would help shade the creek, raise the stream bed, and promote some hyporheic exchange. This channel is narrow, and LWD, boulders, planted trees, and shrubs can create extensive and effective shade.

Restoration of Steinnon Creek Crossing

A site-specific restoration plan was prepared by BLM for the Steinnon Creek crossing. This plan is included as Attachment 3 to this appendix. Similar to the restoration plans prepared for other perennial stream crossings on federal lands (included as attachments to appendix J of the FEIS), this plan focused on ensuring that the desired condition of Steinnon Creek at this location would be reestablished consistent with the Coos Bay District RMP, including the ACS after clearing, construction and restoration activities are completed by Pacific Connector. This plan would be used to supplement the applicants' POD as well as FERC's *Wetland and Waterbody Crossing Plan*.

In summary, this plan provides a general set of best management practices that would be applied based on the crossing risk rating identified by GeoEngineers for the Steinnon Creek crossing. These BMPs are found in Table 1.3-1 of Attachment 3. At the site scale, it summarizes the desired condition that would ensure compliance with the RMP; acknowledges specific resource concerns identified by the BLM during site visits; and provides a list of site-specific prescriptive measures that would be applied in addition to those listed in aforementioned table.

The desired condition upon completion is that the crossing and associated Riparian Reserve provides the functions and values of processes and resources that occur prior to disturbance related to the PCGP Project.

- Soils have been decompacted with hydraulic equipment and are left mounded and discontinuous so that water cannot run straight downhill.
- Effective ground cover has been reestablished prior to the onset of seasonal precipitation to prevent bank erosion and provide shade. Salal/Salmonberry is likely to quickly reoccupy site however erosion control fabric, annual rye or slash may be required for ground cover during the first winter after construction. Riparian vegetation typical to the site has been reestablished to its pre-crossing extent.

- Large woody debris and slash has been used liberally throughout disturbed areas on all slopes to provide effective ground cover and intercept surface runoff. If waterbars have been used, location has been staked on the ground by an Agency representative prior to construction of the waterbar.
- Small woody debris is placed across the channel to initially provide shade. As the wood decays and drops into the channel, the logs but will help raise the stream bed and promote some hyporheic exchange.
- Stream channel banks, substrate composition, streambed gradient and morphology have been restored to their pre-crossing condition.
- Water temperatures reflect the pre-crossing temperature regime.
- Surface flows have not been intercepted by fractured geology.
- Hyporheic/subsurface flows have not been altered by PCGP Project trench backfill.

The primary resource concerns identified by BLM at the Steinnon Creek (Alternative MP 20.25) crossing are:

- Potential increased bank erosion and attendant excess fine sediment accumulation in the channel during peak flow events from construction impacts and crossing configuration during peak flow events,
- Soil compaction and sediment mobilization that may result from stream-side construction during rainy periods in the summer.
- Maintaining likely subsurface flows. It is probable that there is a functioning hyporheic zone associated with Steinnon Creek.
- Whether the trenching operation may capture part of the surface flows. The local massive and brecciated basalt is highly fractured which may intercept surface flows if they are exposed by the trenching operation. Interception or disruption of surface flows would be problematic given the minimal flows in Steinnon Creek during the summer months.
- Effective revegetation of disturbed soils. Soils derived from underlying volcanic deposits may lack sufficient organic material to adequately establish vegetation after disturbance.
- Stream temperatures may increase slightly as a result of shade removal.

If the Blue Ridge Alternative were selected as the preferred route, the BLM would require the following site-specific measures during and following clearing, construction, and restoration activities to comply with the RMP and ensure that the desired condition of this segment of Steinnon Creek would be met.

Construction planning should anticipate at least one bank-full event during the winter, and several moderate to high intensity rainstorms during winter months. Some storm cycles may last several days and be followed in quick succession by another storm. It is critical to leave the site "buttoned up" with effective ground cover in place and earthwork completed prior to the onset of seasonal precipitation. Riparian Reserves at this location extend two tree lengths or 440 feet slope distance either side of the stream channel.

1. Multiple sediment barriers reinforced with erosion control fabric may be needed on the streambank and the slopes immediately above the channel in the first year of construction before effective ground cover and erosion control work are completed.

2. Retain organic material including LWD removed during clearing and construction activities within the Riparian Reserve for placement on exposed soils to provide ground cover and prevent overland flow from occurring. Redistributing organic material (e.g., LWD) generated from the right-of-way clearing operation would be highly successful in preventing raindrop impact and rill erosion. LWD and coarse woody slash would be liberally applied to all disturbed areas above the high water mark as defined on the ground by the BLM.

3. Aggressive erosion control seeding to establish 100 percent effective ground cover needs to be in place on the slope prior to the beginning of seasonal precipitation. Although salal and salmonberry is likely to quickly occupy the site, grass seed and mulch combined with coarse woody debris is the preferred erosion control method for immediate surface cover. Heavy application of grass seed, fertilizer and mulch has proven to be highly successful in preventing rain generated erosion in this area. Table 2.4.1-2 in Attachment 3 of this appendix lists the preferred species for the Coos Bay District BLM. For immediate ground cover, erosion control blankets may be used. The use of wood chips at this site for ground cover is not recommended because wood chips may inhibit success of erosion control seeding.

4. Place LWD across the channel, above the ordinary high water mark to provide shade, maintain the stream gradient, and promote some hyporheic exchange.

5. Replant the area outside the operational right-of-way corridor with conifers using a 50 percent Douglas-fir, 25 percent hemlock and 25 percent red cedar mix. Conifer seedlings need to be protected from browsing deer and elk with biodegradable vexar tubing approved by the BLM until the seedlings are established. Minor amount of dogwood and elderberry may be planted within this zone as well. See Table 2.4.1-3 of Attachment 3 to this appendix for species and planting specifications.

6. Limit stream-side operations during periods of wet weather. Stream-side operations during wet weather have been shown to significantly increase soil compaction and sediment mobilization.

7. Silt barriers may be needed as a temporary measure. If necessary, install appropriate sediment barriers adjacent to the stream channel. This may include silt fences backed with hay bales, fiber rolls and other mechanical methods of intercepting sediment. If upland soils are decompacted and coarse wood and grass seed are used to maximum advantage, silt barriers would likely not be needed once construction is completed.

3.1.4.4 Resources Values and Conditions on BLM Lands: LSRs

Project Impacts of the Blue Ridge Alternative on BLM LSRs

LSRs and their relationship to BLM LMPs are discussed in section 4.1.3.6 of the FEIS. There is no mapped LSR along the Blue Ridge Alternative. There are, however, several unmapped LSRs that would be impacted by the PCGP Project on this alternative route. The location of LSRs in this area is displayed in figure 3.1-1.

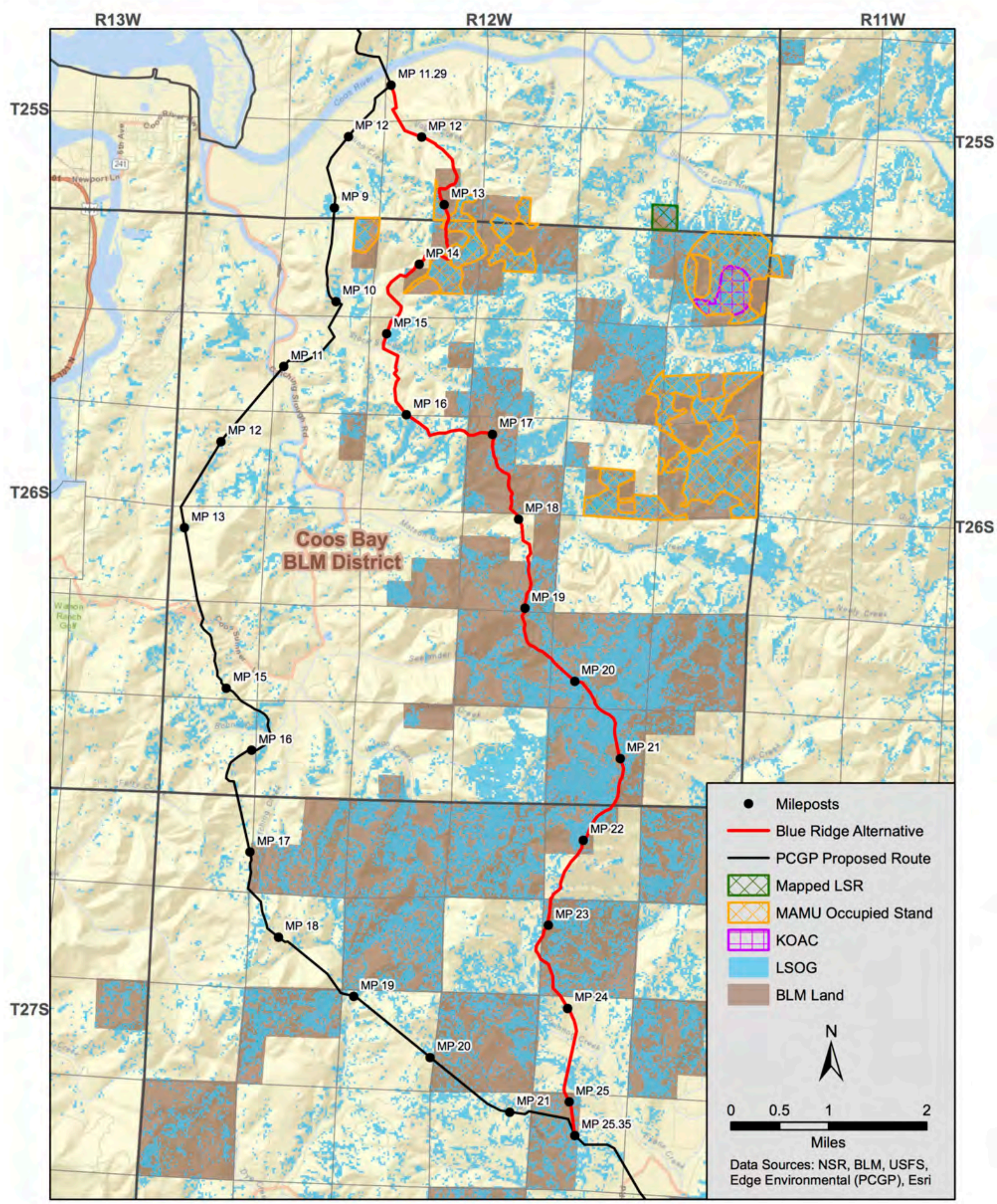


Figure 3.1-1. Map of LSRs Located along the PCGP Blue Ridge Route Alternative

Land Management Plan Amendments Related to LSRs on BLM Lands for the Blue Ridge Alternative

BLM-1, Site-Specific Exemption from Requirements to Protect Marbled Murrelet Habitat in the BLM Coos Bay District

The Coos Bay District RMP would be amended to waive the requirements to protect contiguous existing and recruitment habitat for MAMUs within parts of the Project right-of-way that is within 0.5 mile of occupied MAMU sites, as mapped by the BLM. This is a site-specific amendment applicable only to the Project right-of-way and would not change future management direction at any other location.

Existing known MAMU occupied sites were inventoried using BLM GIS layer data in 2013, and three occupied sites were identified that were in the pipeline corridor along the Blue Ridge Alternative between MP 11.29 and MP 25.35 (see figure 3.1-1). Approximately 6.6 acres of occupied MAMU stands would be cleared by the Pacific Connector pipeline along the Blue Ridge Alternative. Table 3.1.4.4-1 summarizes the existing MAMU occupied stands that would be impacted and the map in figure 3.1-2 displays the existing MAMU occupied stands in relation to the Blue Ridge Alternative.

TABLE 3.1.4.4-1

Known Occupied MAMU Stands within the Pacific Connector Pipeline Project Area in the Coos Bay District on the Blue Ridge Alternative

MAMU Occupied Stand	Milepost Location	Acres Cleared a/, b/
C1027	MP 12.80 - 13.17	2.4
C1040	MP 13.57 - 13.79	2.2
C1042	MP 13.17 – 13.31 MP 13.46 – 13.57	2.1
	Total	**6.6**

a/ Column may not sum correctly due to rounding. Acres rounded to nearest tenth acre.
b/ Cleared acres include the Pacific Connector pipeline construction corridor and temporary extra work areas.
Data Source: BLM GIS data layers

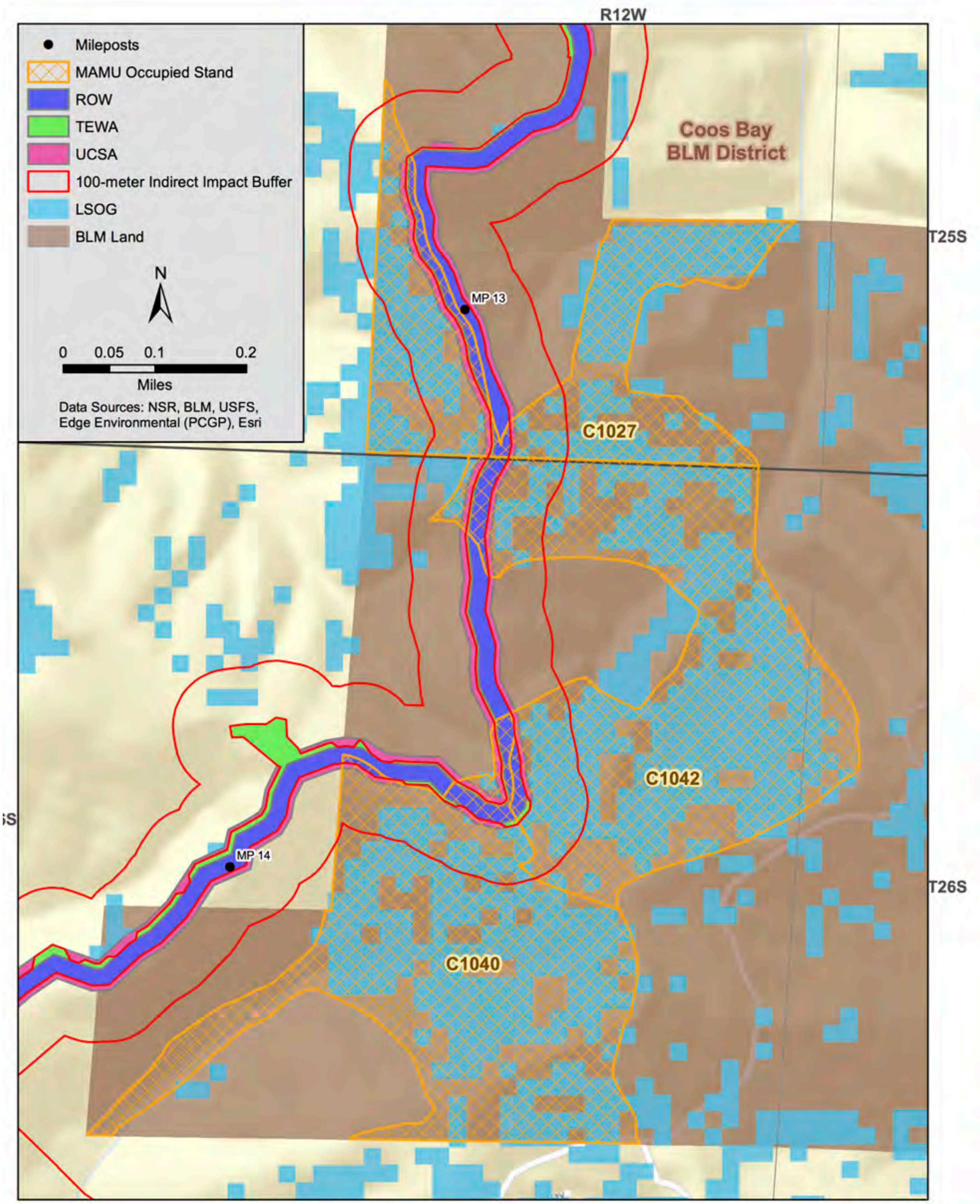


Figure 3.1-2. Map of Known Occupied MAMU Stands Crossed by the PCGP Project on the Blue Ridge Alternative

Wildlife biologists from the BLM reviewed the survey data and determined MAMU occupancy was observed in six of the surveyed areas. The next step in the planning process is BLM biologists will delineate occupied MAMU stands consistent with direction in the Resource Management Plan and protocols for mapping these areas. This task will involve field analysis of these areas and will take some time before it is completed. For the purposes of this analysis occupancy is presumed and impacts are estimated based on the existing stand information in the surveyed areas.[4] Table 3.1.4.4-2 summarizes the presumed occupied MAMU areas impacted by the proposed pipeline and figure 3.1-3 displays the survey areas where MAMU occupancy was observed.

TABLE 3.1.4.4-2

Presumed Occupied MAMU Stands within the Pacific Connector Pipeline Project Area in the Coos Bay District on the Blue Ridge Alternative

MAMU Occupied Stand	Milepost Location	Acres Cleared a/, b/
BR-01	MP 14.1	1.4
BR-03	MP 17.3	5.4
BR-04	MP 17.8	2.2
BR-05	MP 19.2	1.2
BR-06	MP 19.6	0.7
G-120	MP 19.0	2.3
	Total	**13.1**

a/ Column may not sum correctly due to rounding. Acres rounded to nearest tenth acre.
b/ Cleared acres include the Pacific Connector pipeline construction corridor and temporary extra work areas.
Data Source: BLM GIS data layers

[4] The extent of the unmapped LSR on the Blue Ridge Alternative Route is dependent on the final occupied MAMU stand delineations made by BLM biologists.

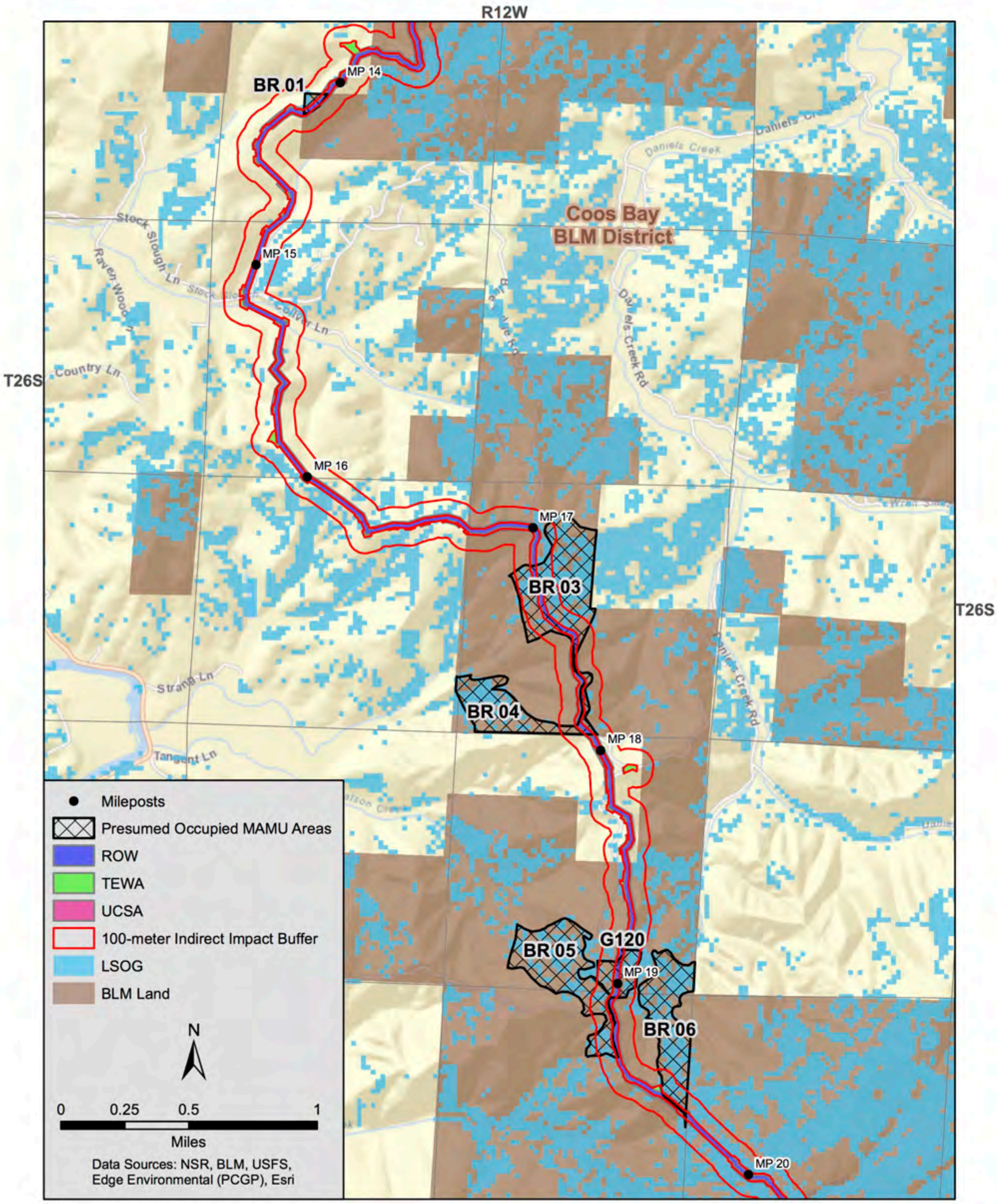


Figure 3.1-3. Map of Surveyed Areas Where MAMU Occupancy was Observed along the Blue Ridge Alternative Route

Amount and Quality of MAMU Habitat Affected by the Construction and Operation of the PCGP Project

Construction of the Pacific Connector pipeline would require clearing approximately 19.7 acres of forest vegetation in these known and presumed occupied MAMU stands. Approximately 7.7 of these acres would be LSOG forest habitat. In addition to the acres that would be cleared there would be an additional 7.7 acres of impact resulting from areas being used as Un-cleared Storage Areas (UCSA). Approximately 2.2 of these acres would occur within LSOG forest. Table 3.1.4.4-3 and figure 3.1-4 summarize the total impacts to known and presumed occupied MAMU stands along the Blue Ridge Alternative Route including the indirect impacts (see section 4.1.3.6. of the FEIS for a discussion of indirect impacts)

TABLE 3.1.4.4-3

Total Pacific Connector Pipeline Project Impacts (a/) on Known and Presumed Occupied MAMU Stands (acres) on the Blue Ridge Alternative

Coos Bay District	Direct Impacts: Cleared	Direct Impacts: Modified	Indirect Impacts	Total Impacts
LSOG	7.7	2.2	47.9	57.8
Non- LSOG	12.0	5.5	15.4	32.9
Non-Forest	0.0	0.0	0.0	0.0
Total	**19.7**	**7.7**	**63.3**	**90.7**

Note: Columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
Data source: BLM GIS Data Layers

a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).

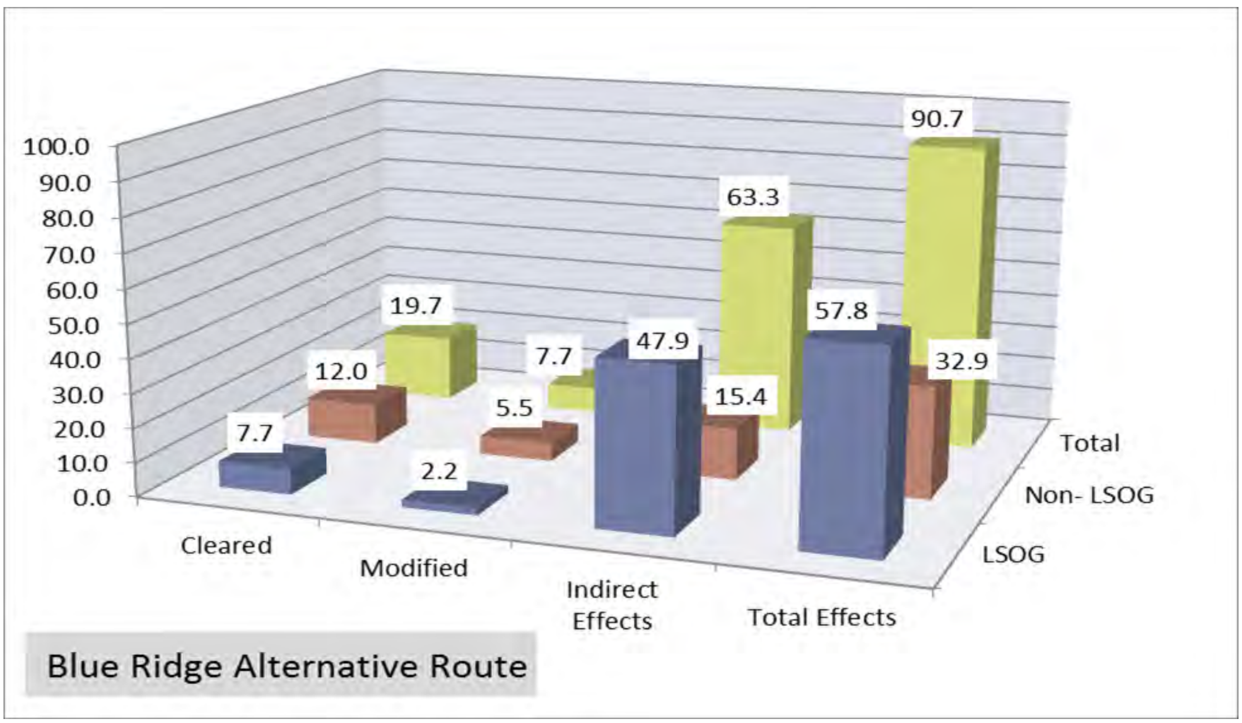


Figure 3.1-4. Pacific Connector Pipeline Project Impacts on Known and Presumed Occupied MAMU Stands in the Blue Ridge Alternative

BLM-4, Reallocation of Matrix Lands to Late-Successional Reserves

The BLM Coos Bay District RMP would be amended to change the designation of approximately 387 acres from the matrix land allocation to the LSR land allocation in Sections 19 and 29, of T.28S., R.10W., W.M., Oregon.

The proposed amendment to reallocate 387 acres from Matrix to LSR is discussed in section 4.1.3.6 of the FEIS (see figures 4.1-11 and 4.1-12 of the FEIS). This proposed amendment would not change with the Blue Ridge Alternative. In addition to the proposed reallocation of matrix to LSR there is also mitigation proposed to reduce the risk of stand replacement fire by constructing 3 heli-ponds. This mitigation is discussed in section 4.1.3.6 of the FEIS and would not change with the Blue Ridge Alternative. As discussed previously the Blue Ridge Alternative would result in additional impacts to known and presumed occupied MAMU stands on the BLM Coos Bay District (see table 3.1.4.4-3). The proposed route of the Blue Ridge Alternative (from approximately MP 11 to MP 22) would not impact any Occupied MAMU Stands (see figure 3.1-1). There are however other Occupied MAMU Stands that would be impacted by the PCGP Project on the BLM Coos Bay District (see map in figure 3.1-5). In considering the proposed amendment to reallocate matrix to LSR it is important to look at all of the LSR that would be impacted by the PCGP Project on the Coos Bay District, not just the portion impacted by the Blue Ridge Alternative. The total amount of known and presumed occupied MAMU stands that would be impacted on the Coos Bay District if the Blue Ridge Alternative was chosen is summarized in table 3.1.4.4-4 and figure 3.1-6.

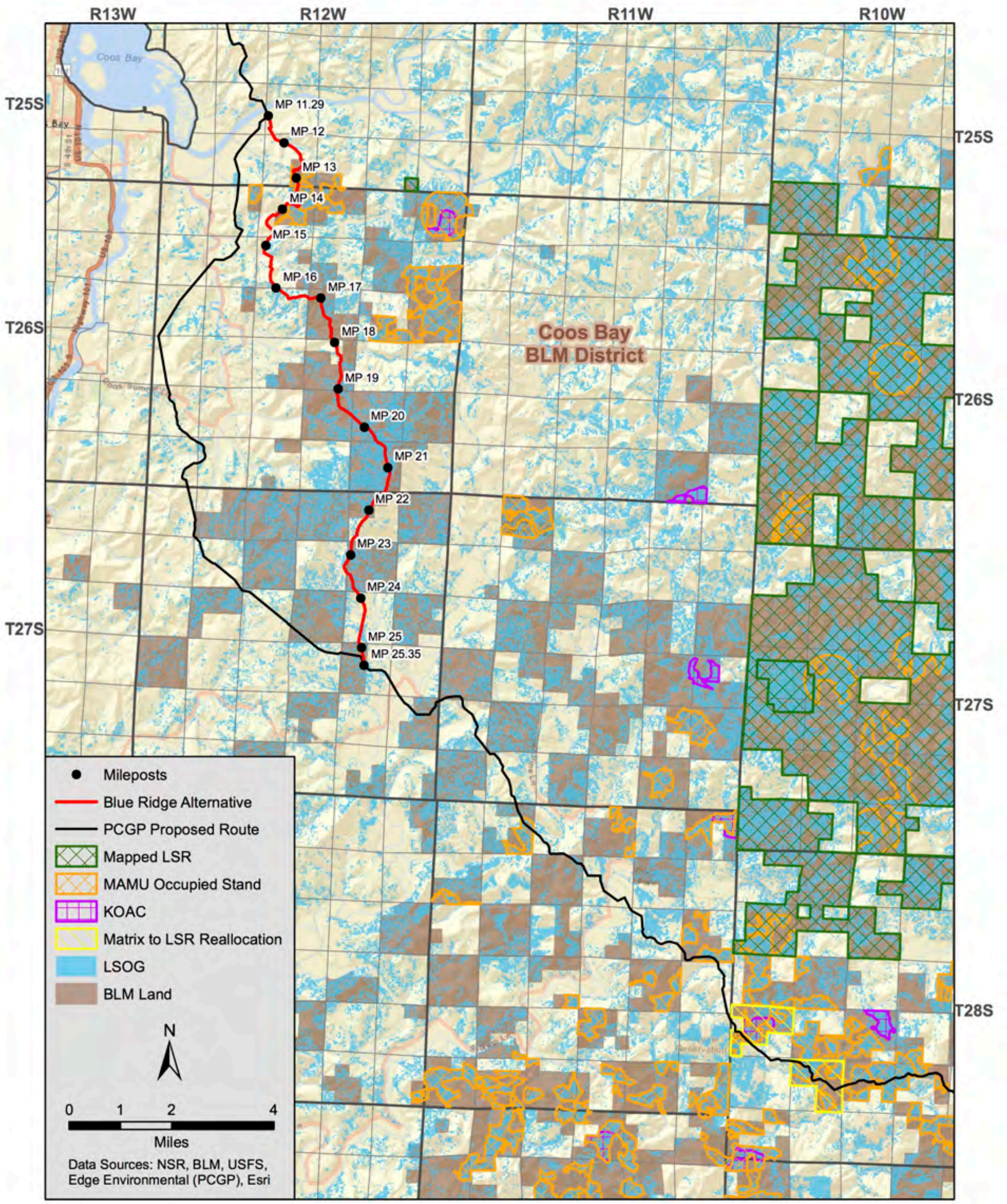


Figure 3.1-5. Map of LSR Impacted by the PCGP Project on the BLM Coos Bay District and the Proposed Matrix to LSR Reallocation Amendment[5]

[5] The presumed occupied MAMU areas on the Blue Ridge Alternative are not shown on this map since the extent of the unmapped LSR areas will not be defined until the BLM biologists have finished the occupied stand delineations.

TABLE 3.1.4.4-4

Blue Ridge Alternative Summary of Total Pacific Connector Pipeline Project Impacts (a/) on Known and Presumed Occupied MAMU Stands and Matrix Reallocated to LSR (acres) in Coos Bay District

Coos Bay District	Direct Impacts: Cleared	Direct Impacts: Modified	Indirect Impacts	Total Impacts	Matrix to LSR Reallocation
LSOG	23	5	198	226	101
Non- LSOG	30	9	46	85	284
Non-Forest	0	0	0	0	2
Total	**52**	**15**	**244**	**311**	**387**

Note: Columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
Data source: BLM, Forest Service GIS Data Layers
a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG).

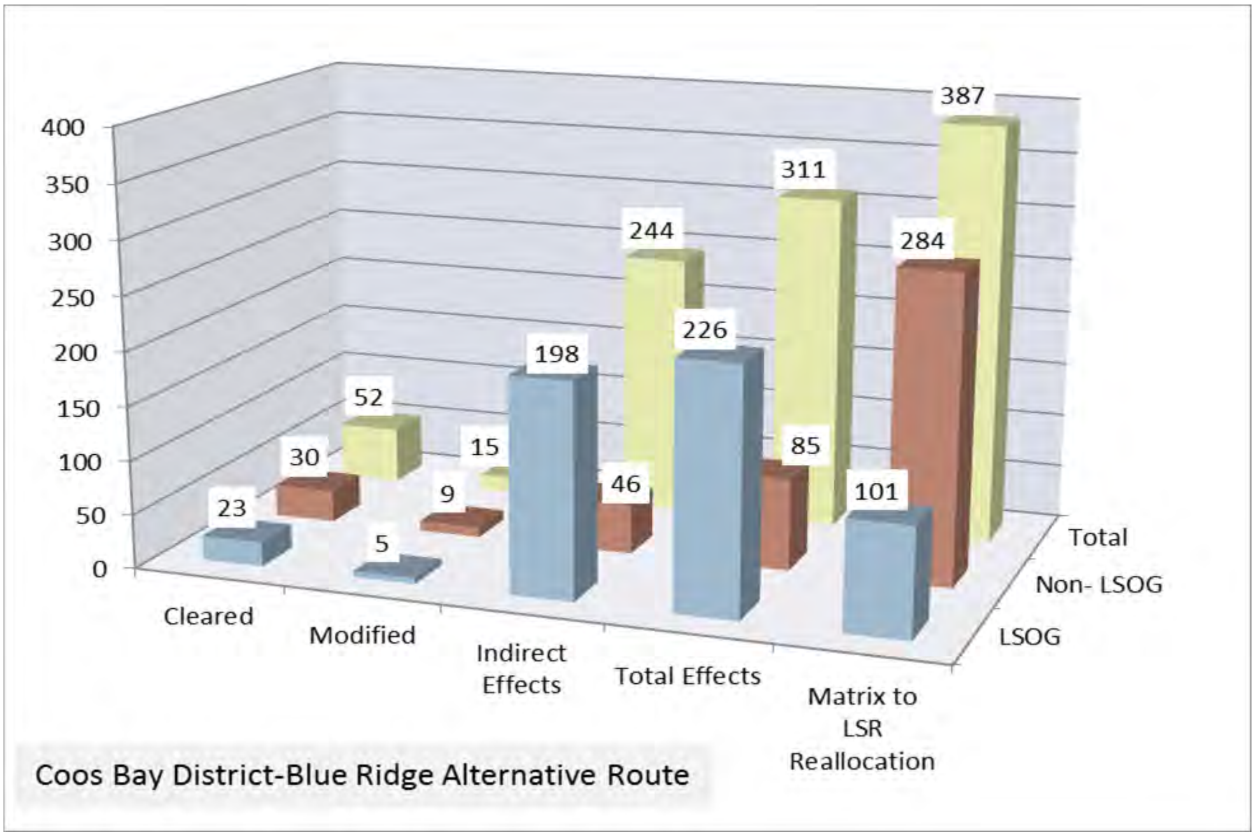


Figure 3.1-6. Summary of Known Occupied MAMU Stands (acres) Impacted by the PCGP Project on the BLM Coos Bay District

Aggregated Impact of the Pacific Connector Pipeline Project on Mapped and Unmapped LSRs in the BLM Coos Bay District for the Blue Ridge Alternative

Approximately 101 acres of the 387 acres of Matrix lands being reallocated contain LSOG forest habitat. A comparison of the total LSR acres that would be affected by the Blue Ridge Alternative in the BLM Coos Bay District (in both mapped and unmapped LSRs) and the Matrix acres reallocated to LSR is summarized in table 3.1.4.4-5 and figure 3.1-7.

TABLE 3.1.4.4-5

Blue Ridge Alternative Summary of the PCGP Project Total Impacts (a/) on LSRs and Matrix Reallocated to LSR (acres) in BLM Coos Bay District

Coos Bay District	Direct Impacts: Cleared	Direct Impacts: Modified	Indirect Impacts	Total Impacts	Matrix to LSR Reallocation
LSOG	25	5	212	242	101
Non- LSOG	59	12	88	160	284
Non-Forest	0	0	0	0	2
Total	**84**	**18**	**300**	**402**	**387**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as “<1”).
a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG) in both mapped and unmapped LSR.
Data source: BLM, Forest Service GIS Data Layers

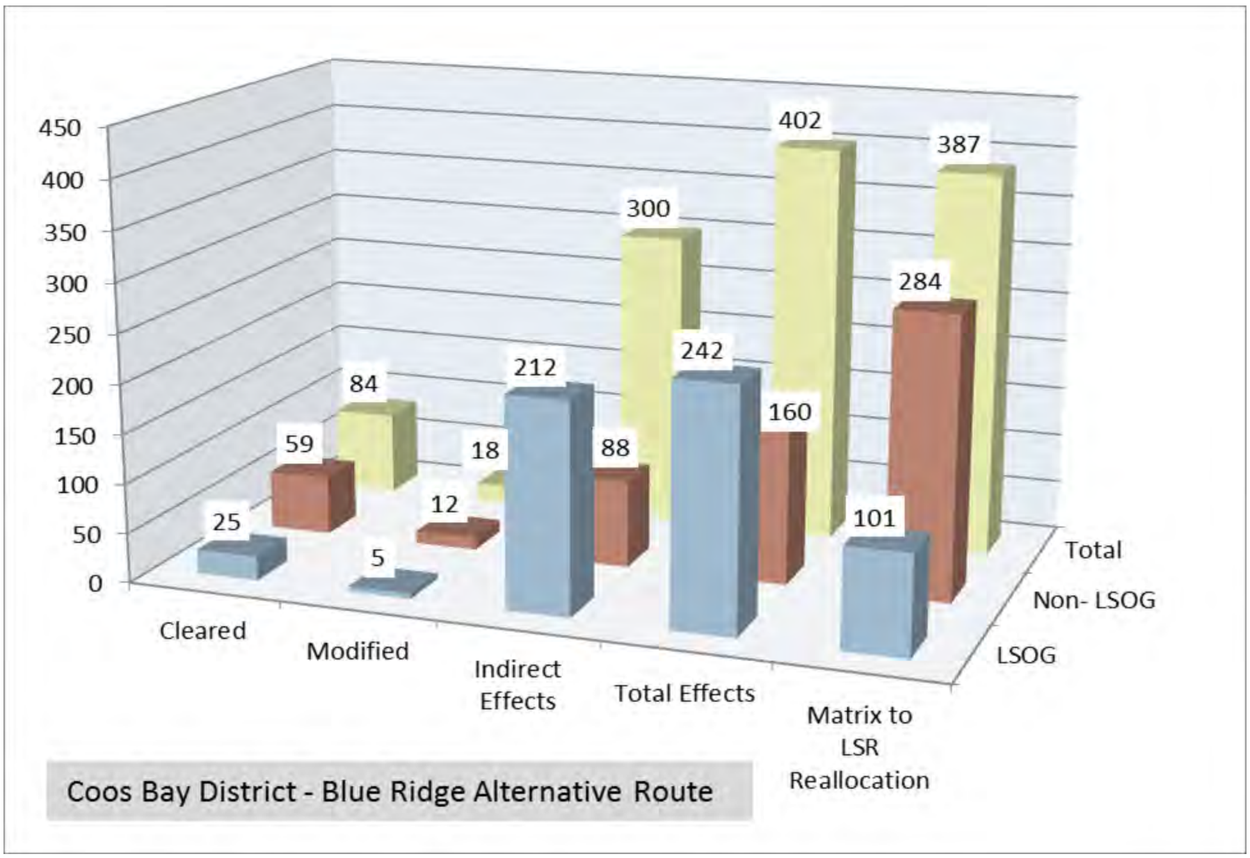


Figure 3.1-7. Blue Ridge Alternative Comparison of the Total PCGP Project Impacts on LSRs and Matrix to LSR Reallocation

In comparing the total amount of LSOG within LSRs that would be cleared with the Blue Ridge Alternative with the amount of LSOG that would be reallocated to LSR there would be approximately 4 acres added to the reserve system for each acre cleared by the project in the BLM Coos Bay District. This compares with approximately 6 acres added to the reserve system for each acre cleared by the project in the BLM Coos Bay District with the proposed route. The Blue Ridge Alternative would impact more acres of LSR on the BLM Coos Bay District than the proposed route. Table 3.1.4.4-6 and figure 3.1-8 compares the total impacts to LSR between the proposed route and the Blue Ridge Alternative.

TABLE 3.1.4.4-6

Comparison of the PCGP Project Total Impacts (a/) on LSRs (acres) between the Proposed Route and the Blue Ridge Alternative in BLM Coos Bay District

	LSOG			Non-LSOG			Total Overall		
Coos Bay District	**Direct Impacts**	**Indirect Impact**	**Total**	**Direct Impact**	**Indirect Impact**	**Total**	**Direct**	**Indirect**	**total**
Proposed Route	20	164	184	54	73	127	75	237	312
Blue Ridge Alternative	30	212	242	72	88	160	102	300	402

a/ Project total impacts include cleared acres (corridor and temporary extra work areas), modified acres (uncleared storage areas), and indirect effect acres (100 meters on each side of the cleared corridor edge in late successional and old-growth (LSOG) forest and 30 meters on each side of the cleared corridor edge in non-LSOG) in both mapped and unmapped LSR.
Data source: BLM, Forest Service GIS Data Layers

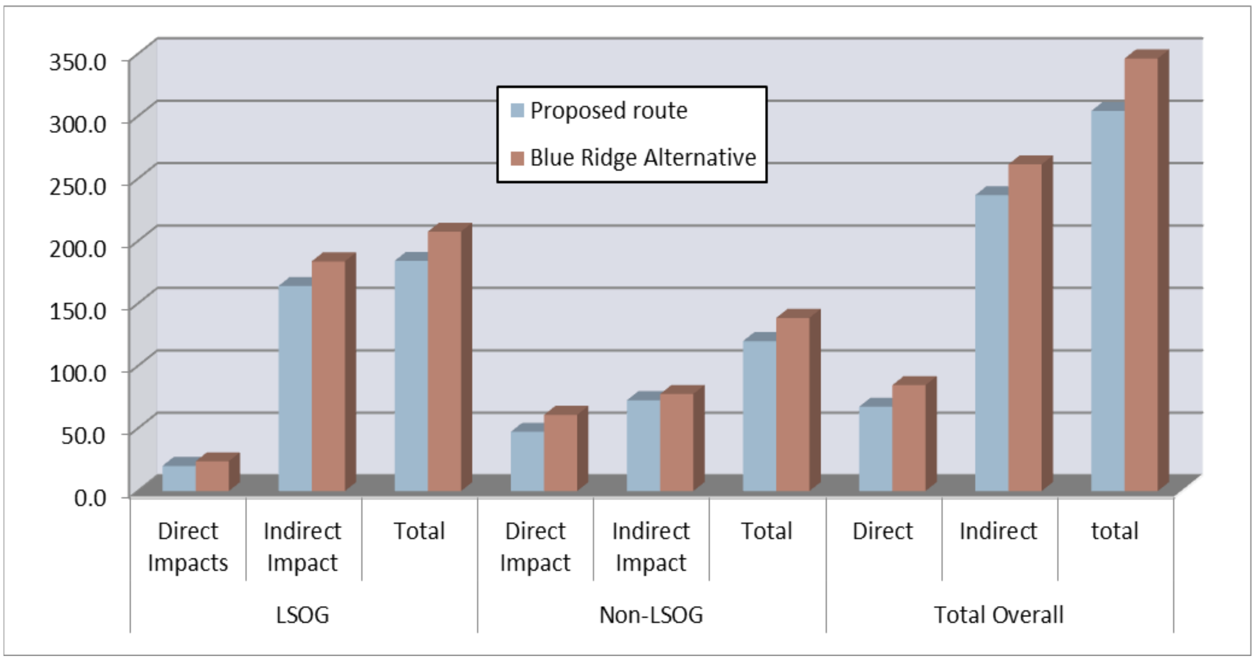


Figure 3.1-8. Comparison of the PCGP Project Total Impacts on LSRs (acres) between the Proposed Route and the Blue Ridge Alternative in BLM Coos Bay District

Considering overall impacts (both direct and indirect) the Blue Ridge Alternative would affect approximately 90 more acres of LSR than the proposed route.

3.2 GEOLOGICAL RESOURCES

3.2.1 Coast Region

The Blue Ridge Alternative and comparison portion of the proposed route are located entirely within the Oregon Coast Range Physiographic Province. This province extends more than 200 miles from the Columbia River south past Coos Bay to the Klamath Mountains. The Coast Range is 30 to 60 miles wide and averages 1,500 feet in elevation, with the highest point reaching 4,097 feet.

Coastal uplift of the present Coast Range over the past 10 to 15 million years has occurred simultaneously with stream incision and coastal erosion and depositional processes. Inland from the coastal areas, the Coast Range is generally composed of relatively soft marine sedimentary rock units that overlie basalt at depth. The wet conditions of the western slopes of the Coast Range, along with steep terrain underlain by relatively weak rock, contribute to an active erosional environment with frequent landslides (GeoEngineers 2015[6]).

3.2.1.1 Site Geology

The site geology for the proposed route is provided in Resource Report 6 of Pacific Connector's June 2013 application. The site geology for the Blue Ridge Alternative includes Quaternary-age marine terrace deposits as well as sedimentary and volcanic rocks of Eocene age (GeoEngineers 2015).

3.2.1.2 Seismic Setting and Hazards

Seismic Hazards

Seismic hazards considered in the GeoEngineers (2015) updated evaluation of the Blue Ridge Alternative and comparison portion of the proposed route included ground surface fault rupture, earthquake-induced liquefaction and earthquake-induced lateral spreading. Neither the Blue Ridge Alternative nor the proposed route comparison portion cross mapped Quaternary-age faults.

A desktop evaluation identified two alluvial valley segments along the Blue Ridge Alternative with the potential for liquefaction-induced settlement: Coos River/Vogel Creek Valley (MP 11.29R to MP 12.1) and Stock Slough (MP 15.1 to MP 15.3). Analysis of boring data indicate a high risk for liquefaction at the Coos River Valley. Additional data would be needed to further assess the hazard at Stock Slough. The comparison portion of the proposed route crosses four valley segments with the potential for liquefaction/lateral spreading: Coos River (MP 11.1R to MP 12.6R), Stock Slough (MP 10.1 to MP 10.4), Catching Slough (MP 10.8 to MP 11.4), and Boone Creek (MP 15.72 to MP 15.77) (GeoEngineers 2015).

Landslide Hazards

Based on published sources, including the Oregon Department of Geology and Mineral Industries (DOGAMI) open file report 0-11-01 and Statewide Information Database for Oregon (SLIDO), the comparison portion of the proposed route would cross five landslide areas for a total of 7,137 feet. The Blue Ridge Alternative would cross two landslides for a total of 3,267 feet. GeoEngineers (2015) also reviewed aerial photography and light detection and ranging (LiDAR) hillshade model data to identify landslide hazards. Based on this analysis, the comparison portion of the proposed route and Blue Ridge Alternative would both cross two landslides totaling 3,257 feet and 1,088 feet, respectively (GeoEngineers 2015).

[6] GeoEngineers. 2015. Revised Geological Hazards Evaluation of the PCGP Modified Blue Ridge Route Alternative. July 17, 2015.

3.2.1.3 Rock Sources and Permanent Disposal Sites

Table 3.2.1.3-1 lists the rock source and disposal sites for the comparison portion of the proposed route. All would be located on private land, primarily forest land that has been harvested previously. There are no rock source and disposal sites for the Blue Ridge Alternative.

TABLE 3.2.1.3-1

Rock Source and/or Permanent Disposal Sites – Proposed Route (Comparison)

Site	Size (acres)	Milepost	Land Use	Jurisdiction
Coos County				
TEWA-11.90-W	0.10	11.90	Mixed forest land, regenerating evergreen forest land	Private
TEWA 12.53-N	2.32	12.53	Clearcut forest land, transportation, communication, utilities corridors	Private
TEWA 14.60-N	0.61	14.60	Regenerating evergreen forest land, transportation, communication, utilities corridors	Private
TEWA 17.82-W	0.93	18.11	Regenerating evergreen forest land	Private
TEWA 20.96	2.00	20.96	Clearcut forest land, regenerating evergreen forest land	Private
TOTAL	**5.96**			

3.2.1.4 Blasting During Trench Excavation

The Blue Ridge Alternative would cross 2,379 feet of terrain with soils less than 5 feet from the ground surface to non-rippable bedrock, which is rated as having a high potential for blasting (GeoEngineers 2015). Along the comparison portion of the proposed route, the blasting potential is considered low.

3.3 SOILS AND SEDIMENTS

3.3.1 Pacific Connector Pipeline and Associated Facilities

Soil associations crossed by the comparison portion of the proposed route and Blue Ridge Alternative are shown in tables 3.3.1-1a and 3.3.1-1b by MP, including the mileage percentage of the route lengths. The comparison portion of the proposed route crosses three soil associations, though the majority (66 percent) crosses just one, the Templeton-Salander-Reedsport-Fendal association. The Blue Ridge Alternative crosses five associations, dominated by two groups: Preacher-Bohannon (41 percent) and Peavine-Olyic-Melby-Honeygrove-Blachly (32 percent).

TABLE 3.3.1-1a

Soil Associations Crossed by the Pacific Connector Pipeline – Proposed Route (Comparison)

From	To	County	Soil Association (STATSGO)	Total Crossing Length (miles) a/	Percent of Project Mileage
MLRA 4A – Sitka Spruce Belt – MPs 11.29R to 19.22					
11.29R 10.6	9.11 11.34	Coos	Nehalem- Duneland Bullards (s6398)	2.4	16%
9.11 11.34	10.6 19.22	Coos	Templeton- Salander-Reedsport-Fendall (s6399)	9.4	66%
			Total miles	**11.8**	
MLRA 1 – Northern Pacific Coast Range, Foothills, and Valleys – MPs 19.22 to 21.77					
19.22	21.8	Coos	Peavine-Olyic-Melby-Honeygrove-Blachly (S6396)	2.6	18%
			Total miles	**2.6**	
			Project Total (miles)	**14.4**	

a/ Mileages are rounded to the nearest tenth of a mile; therefore, column may not sum correctly.

TABLE 3.3.1-1b

Soil Associations Crossed by the Pacific Connector Pipeline – Blue Ridge Alternative

From	To	County	Soil Association (STATSGO)	Total Crossing Length (miles) a/	Percent of Project Mileage
MLRA 4A – Sitka Spruce Belt – MPs 11.29R R to 19.22					
11.29	11.72	Coos	Nehalem-Duneland Bullards (s6398)	0.4	3%
11.72 15.34	13.95 15.73	Coos	Tolovana-Templeton-Salander-Reedsport-Fendall (s6399)	2.6	19%
			Total miles	**3.0**	
MLRA 1 – Northern Pacific Coast Range, Foothills, and Valleys – MPs 19.22 to 23.35R					
20.14 24.64	23.92 25.34	Coos	Peavine-Olyic-Melby-Honeygrove-Blachly (s6396)	4.5	32%
23.92	24.64	Coos	Nekoma-Meda-Kirkendall-Eilertsen (s6402)	0.7	5%
13.95 15.73	15.34 20.14	Coos	Preacher-Bohannon (s6395)	5.8	41%
			Total miles	**11.0**	
			Route Total (miles)	**14.00**	

a/ Mileages are rounded to the nearest tenth of a mile; therefore, column may not sum correctly.

Tables 3.3.1-2a and 3.3.1-2b provide a summary of soil limitations that could be encountered by the comparison portion of the proposed route and Blue Ridge Alternative, respectively. Table 3.3-3 summarizes soil limitations associated with the aboveground facilities. These limitations are described further in subsections following the tables.

TABLE 3.3.1-2a

Acreages and Soil Characteristics Crossed by the Pacific Connector Pipeline – Proposed Route (Comparison)

Milepost From	Milepost To	Total Crossing Length (miles)	County	Sensitive Soil Groups and Estimated Crossing in Miles (acres) a/: Erosion From Water b/	Erosion From Wind c/	Steep Slopes d/	Large Stones e/	Restrictive Layer f/	Saline/Sodic g/	Soil Compaction h/	Reclamation Sensitivity i/	High Water Table j/	Hydric Soils k/	Prime farmland l/
11.29R 10.60	9.11 11.34	2.4	Coos	0.4 (7)	0.0	0.4 (7)	0.0	0.7 (11)	0	2.4 (45)	0.4 (7)	1.6 (34)	1.6 (32)	1.6 (34)
9.11 11.34	10.60 19.22	9.4	Coos	5.5 (81)	0.0	5.5 (81)	0.0	7.7 (118)	0.0	9.4 (144)	5.5 (81)	0.6 (10)	0.6 (9)	2.3 (40)
19.22	21.77	2.6	Coos	1.8 (28)	0.0	1.8 (28)	0.0	0.0 (<0.1)	0.0	2.6 (38)	1.8 (28)	0.0	0.0	0.0
	Project Total	**14.4**	**All**	**7.7 (116)**	**0.0**	**7.7 (116)**	**0.0**	**8.4 (129)**	**0.0**	**14.4 (227)**	**7.7 (116)**	**2.2 (44)**	**2.2 (41)**	**3.9 (74)**
			Percentage	**53%**	**0%**	**53%**	**0%**	**58%**	**0%**	**100%**	**53%**	**15%**	**15%**	**27%**

Rows and columns may not add correctly due to rounding. Acres rounded to nearest whole acre, miles to nearest tenth of a mile (values below 1 or 0.1, respectively, are shown as "<1"/ "<0.1").

a/ Numerical values shown are miles crossed by construction, including construction right-of-way and TEWAs. Acres affected shown in parenthesis. Soil data from NRCS 2004; SCS (1985, 1989, 1993); Forest Service 1976, 1977, and 1979. NRCS State Soil Geographic Database (STATSGO and SSURGO) soil classifications (NRCS 2012a).

b/ Soils with NRCS rating of high or severe.

c/ Soils with NRCS wind erodibility groups 1 and 2.

d/ Soils with slopes greater than 30 percent. Based on NRCS mapping unit slope range.

e/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.

f/ Soils with a restrictive soil layer (bedrock or cemented layer) within 60 inches of the soil surface.

g/ Soils with an electrical conductivity of 8 mmhos/cm or greater and/or a Sodium Adsorption Ratio (SAR) of 13 or greater.

h/ Soils with an NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category.

i/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop.

j/ Soils saturated within 60 inches of the surface in most years.

k/ Soils with at least one major named map unit included on the county hydric soil list.

l/ Soils with dominant map unit included on either the state or county list of farmland of importance.

TABLE 3.3.1-2b

Acreages and Soil Characteristics Crossed by the Pacific Connector Pipeline – Blue Ridge Alternative

Milepost From	Milepost To	Total Crossing Length (miles)	County	Erosion From: Water b/	Erosion From: Wind c/	Steep Slopes d/	Large Stones e/	Restrictive Layer f/	Saline/Sodic g/	Soil Compaction h/	Reclamation Sensitivity i/	High Water Table j/	Hydric Soils k/	Prime farmland l/
11.29	11.72	0.43	Coos	0.0	0.0	0.0	0.0	0.0	0.0	0.4 (8)	0.0	0.4 (8)	0.4 (7)	0.4 (8)
11.72 15.34	13.95 15.73	2.61	Coos	0.7 (9)	0.2 (3)	0.8 (10)	0.0	2.1 (31)	0.0	2.4 (36)	0.5 (9)	0.5 (8)	0.2 (4)	0.5 (8)
20.14 24.64	23.92 25.35	4.48	Coos	3.2 (44)	0.0	1.3 (17)	0.5 (7)	0.5 (7)	0.0	4.0 (54)	3.2 (44)	0.0	0.0	0.0
23.92 22.40	24.64 30.31	0.72	Coos	0.1 (2)	0.0	0.1 (2)	0.0	0.0	0.0	0.7 (9)	0.1 (2)	0.1 (2)	0.1 (2)	0.1 (2)
13.95 15.73	15.34 20.14	5.75	Coos	2.7 (37)	0.5 (7)	3.2 (45)	<0.1 (0.5)	4.5 (63)	0.0	5.3 (75)	2.7 (37)	0.6 (8)	0.6 (8)	0.9 (13)
Project Total		**14.0**		**6.7 (92)**	**0.7 (10)**	**5.4 (74)**	**0.5 (7.5)**	**7.1 (101)**	**0.0**	**12.8 (182)**	**6.5 (92)**	**1.6 (26)**	**1.3 (21)**	**1.9 (31)**
			Percentage	**48%**	**5%**	**39%**	**4%**	**51%**	**0%**	**91%**	**46%**	**11%**	**9%**	**14%**

Rows and columns may not add correctly due to rounding. Acres rounded to nearest whole acre, miles to nearest tenth of a mile (values below 1 or 0.1, respectively, are shown as "<1"/ "<0.1").

a/ Numerical values shown are miles crossed by construction, including construction right-of-way and TEWAs. Acres affected shown in parenthesis. Soil data from NRCS 2004; SCS (1985, 1989, 1993); Forest Service 1976, 1977, and 1979. NRCS State Soil Geographic Database (STATSGO and SSURGO) soil classifications (NRCS 2012a).
b/ Soils with NRCS rating of high or severe.
c/ Soils with NRCS wind erodibility groups 1 and 2.
d/ Soils with slopes greater than 30 percent. Based on NRCS mapping unit slope range.
e/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.
f/ Soils with a restrictive soil layer (bedrock or cemented layer) within 60 inches of the soil surface.
g/ Soils with an electrical conductivity of 8 mmhos/cm or greater and/or a Sodium Adsorption Ratio (SAR) of 13 or greater.
h/ Soils with an NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category.
i/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop.
j/ Soils saturated within 60 inches of the surface in most years.
k/ Soils with at least one major named map unit included on the county hydric soil list.
l/ Soils with dominant map unit included on either the state or county list of farmland of importance.

TABLE 3.3.1-3

Summary of Soils Limitations – Pacific Connector Pipeline Aboveground Facilities

Proposed Facility	Area (ac) a/	Soil Mapping Unit (STATSGO)	High Erosion Potential b/	Steep Slopes c/	Large Stones d/	Restrictive Layer e/	Saline/ Sodic f/	High Compaction Potential g/	Poor Revegetation Potential h/	High Water Table i/	Hydric Soil j/	Prime Farmland k/
MLV #2 (Boone Creek Road) **(Proposed Route)**	<1	S6399 (54F)	Water	Yes	No	Yes	No	No	Yes	No	No	No
MLV #2 (Stock Slough Rd # 54) **(Blue Ridge Alternative)**	<1	S6399 (62)	No	No	No	No	No	No	No	Yes	Yes	Yes
Blue Ridge Communication Site **(Both routes)**	<1	S6396 (4D)	Water	No	No	No	No	Yes	Yes	No	No	No

Notes refer to complete project (232 miles).

Soil data from NRCS (2004); SCS (1985, 1989, 1993); Forest Service (1976, 1977, and 1979). NRCS State Soil Geographic Database (STATSGO and SSURGO) soil classifications (NRCS 2012a).

a/ Area of construction and operation disturbance. Construction disturbance is included within the pipeline construction right-of-way. Acreages rounded to nearest whole acre; values less than 1 are reported as <1.

b/ Soils with NRCS rating of high or severe.

c/ Soils with slopes greater than 30 percent.

d/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.

e/ Soils with a restrictive soil layer (bedrock or cemented layer) within 60 inches of the soil surface.

f/ Soils with an electrical conductivity of 8 mmhos/cm or greater and/or a SAR of 13 or greater.

g/ Soils with an NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category.

h/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop.

i/ Soils saturated within 60 inches of the surface in most years.

j/ Soils with at least one major named map unit included on the county hydric soil list.

k/ Soils with dominant map unit included on either the state or county list of farmland of importance.

3.3.1.1 Project-Specific Soil Limitations

Prime Farmland

The Blue Ridge Alternative would cross 1.9 miles (31 acres) of prime farmland, about 14 percent of the route, while the comparison portion of the proposed route would cross 3.9 miles (74 acres), about 27 percent of is length (tables 3.3.1-2a and 3.3.1-2b). Of the aboveground facilities for this section of the route, only the Blue Ridge Alternative MLV #2 site would affect prime farmland (table 3.3.1-3).

Topsoil salvaging and segregation would occur in areas mapped as prime farmland or where there are active crops to minimize potential impacts to soil and agricultural productivity. Areas where topsoil salvaging and segregation would occur are shown by MP for each route in table 3.3.1.1-1.

TABLE 3.3.1.1-1

Areas Where Topsoil Would be Salvaged Along the Pacific Connector Pipeline – Proposed Route (Comparison)

Area/Land Use	From (MP)	To (MP)
Proposed Route (Comparison)		
Wetland/Pasture	11.29R	12.39R
Wetland/Pasture	8.58	8.67
Wetland/Pasture	10.05	10.40
Wetland/Pasture	10.81	11.08
Wetland/Pasture	11.14	11.39
Residential	14.24	14.29
Wetland/Pasture	15.70	15.78
Blue Ridge Alternative		
Wetland/Pasture	11.29R	12.11R
Wetland/Pasture	14.66R	15.34R
Wetland/Pasture	24.31R	24.34

Hydric Soils

Construction activities have the potential to result in structural damage to wet soils and soils with poor drainage. The comparison portion of the proposed route would cross 2.2 miles (41 acres) of hydric soils, about 15 percent of the route, and the Blue Ridge Alternative would cross 1.3 miles (21 acres) of hydric soils, about 9 percent of the route (tables 3.3.1-2a and 3.3.1-2b). Of the aboveground facilities for this section of the route, only the Blue Ridge Alternative MLV #2 site would affect hydric soils (table 3.3.1-3).

High Water Table

Soils that have a high water table have a saturated zone in the soil profile within 60 inches of the surface in most years. Soils that are wet or poorly drained can experience structural damage from construction equipment. The comparison portion of the proposed route would cross 2.2 miles (41 acres) of high water table soils, about 15 percent of the route, and the Blue Ridge Alternative would cross 1.6 miles (26 acres), about 11 percent of the route (tables 3.3.1-2a and 3.3.1-2b). Of the aboveground facilities for this section of the route, only the Blue Ridge Alternative MLV #2 site would affect soils with a high water table (table 3.3.1-3).

Erosion Potential

The comparison portion of the proposed route crosses soils with a high or severe water erosion rating for 7.7 miles (116 acres), or 53 percent of the route. No soils identified as sensitive to wind erosion are crossed by the comparison portion of the proposed route (table 3.3.1-2a). The Blue Ridge Alternative would cross soils with a high or severe water erosion rating for 6.7 miles (92 acres), about 48 percent of the route. The Blue Ridge Alternative would also cross a short distance, 0.7 mile (10 acres), of soils sensitive to wind erosion (table 3.3.1-2b). The MLV #2 site for the proposed route and the Blue Ridge Communication Site (both routes) would be on soils with high water erosion potential (table 3.3.1-3).

Revegetation Potential

The comparison portion of the proposed route would cross 7.7 miles (116 acres) of soils with poor revegetation potential, or reclamation sensitivity, which is about 53 percent of the route (table 3.3.1-2a). The Blue Ridge Alternative would cross 6.5 miles (92 acres) of soils with poor revegetation potential, about 46 percent of the route (table 3.3.1-2b). The MLV #2 site for the proposed route and the Blue Ridge Communication Site (both routes) would be on soils with poor revegetation potential (table 3.3.1-3).

Compaction Potential

The full length of the comparison portion of the proposed route crosses soils that are highly susceptible to compaction, for a total of 14.4 miles (227 acres) (table 3.3.1-2a). The majority of the Blue Ridge Alternative also crosses soils with high compaction potential, totaling 12.8 miles (182 acres), or 91 percent of the route (table 3.3.1-2b). Of the aboveground facilities, only the potential Blue Ridge Communication Site (both routes) would affect soils with high compaction potential (table 3.3.1-3).

Restrictive Layer

Soils that are rated as having a restrictive layer are shallow soils that have a lithic, paralithic, or other restrictive soil layer within 60 inches of the soil surface. The comparison portion of the proposed route would cross 8.4 miles (129 acres) of soils with a restrictive layer, or 58 percent of the route (table 3.3.1-2a). The Blue Ridge Alternative would cross 7.1 miles (101 acres) of soils with a restrictive layer, about 51 percent of the route (table 3.3.1-2b). Of the aboveground facilities, only the MLV #2 site for the proposed route would be on soils with a restrictive layer (table 3.3.1-3).

Steep Slopes

The comparison portion of the proposed route would cross 7.7 miles (116 acres) of soils with slopes greater than 30 percent, about 53 percent (table 3.3.1-2a). The Blue Ridge Alternative would cross 5.4 miles (74 acres) of soils with slopes greater than 30 percent, or 39 percent of the route (table 3.3.1-2b). These crossing lengths are based on soil mapping units. However, when reviewing detailed contour data developed from a digital elevation model (DEM), both routes would cross fewer steep slope areas. Based on the DEM, the Blue Ridge Alternative would cross 1.2 miles (8.6 percent) of slopes that are 30 percent or greater, and the comparison portion of the proposed route would cross 2.1 miles (14.6 percent) of slopes 30 percent or greater. Of the aboveground facilities, only the MLV #2 site for the proposed route would be on steep slopes (table 3.3.1-3).

Large Stones

The Blue Ridge Alternative would cross 0.5 mile (7.5 acres) of soils that have a content of cobbles or stones greater than 25 percent, and the comparison portion of the proposed route segment would not cross any such soils (tables 3.3.1-2a and 3.3.1-2b). None of the aboveground facilities would affect soils with large stones (table 3.3.1-3).

Contaminated Soils

There are no identified cleanup sites along either the Blue Ridge Alternative or comparison portion of the proposed route. The closest site to the Blue Ridge Alternative is Site 2184 – Woodward Creek Oil Release, which is approximately one mile east of MP 21.9. The closest site to the proposed route segment is Site 746 – JGS Precision Machine, which is approximately 0.75 mile east of MP 15.4. No other sites are within one mile of the right-of-way of either route.

3.3.1.2 Soil Limitations on BLM Lands

Table 3.3.1.2-1 presents the acres of soil conditions along the comparison portion of the proposed route and Blue Ridge Alternative, by type of soil limitation. As the Blue Ridge Alternative crosses more BLM lands, acres of soils with limitations are also greater than the comparison portion of the proposed route on BLM lands.

TABLE 3.3.1.2-1

Acres of Soil Conditions Along the Pacific Connector Pipeline on BLM Lands (Coos Bay District), by Alternative

Watershed	Total ROW Acres of BLM lands a/	Areas with High Erosion Potential b/	Slopes >30 percent c/	High Cobble and Stone Content d/	High Compaction Potential e/	Low Revegetation Potential f/	Areas with Shallow Soils 12-20 inches / <12 inches
Proposed Route (Comparison)							
Coos Bay Frontal	3	2	2	0	3	2	0
Coquille River	1	1	1	0	1	1	0
North Fork Coquille River	15	10	10	0	15	10	0
Total	**19**	**13**	**13**	**0**	**19**	**13**	**0**
Blue Ridge Alternative							
Coos Bay Frontal	41	21	23	0	41	21	0
South Fork Coos River	17	13	10	0.5	17	13	0.5
North Fork Coquille River	44	33	9	3	41	33	0
Total	**102**	**67**	**42**	**3.5**	**99**	**67**	**0.5**

Rows and columns may not add correctly due to rounding. Acreages are rounded to nearest whole acre.

a/ Figures shown are acres affected by construction, including construction right-of-way and TEWAs. Soil data from NRCS (2004, 2006a, 2006b); SCS (1985, 1989, 1993); and Forest Service (1976, 1977, 1979).

b/ Soils with NRCS rating of high or severe.

c/ Soils with slopes greater than 30% based on NRCS soil mapping unit slope ranges.

d/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.

e/ Soils with an NRCS rating of high or severe for the *Haul Roads, Log Landings, and Soil Rutting* category, Or NF SRI compaction potential ratings.

f/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop.

g/ Soils saturated within 60 inches of the surface in most years.

3.4 WATER RESOURCES AND WETLANDS

3.4.1 Groundwater

There would be no groundwater wells within 150 feet of the Blue Ridge Alternative or comparison portion of the proposed route. The Blue Ridge Alternative would cross one mile of shallow groundwater, and the comparison portion of the proposed route would cross 2.2 miles of shallow groundwater. Overall, both the Blue Ridge Alternative and comparison portion of the proposed route have a low potential for impacting groundwater resources. For a general discussion of impacts from blasting, see section 4.4.1.2 of the FEIS. As indicated above, less than a half mile of the Blue Ridge Alternative may require blasting, and none of the comparison portion of the proposed route.

3.4.2 Surface Water

The Blue Ridge Alternative and comparison portion of the proposed route would both be within the Coos and Coquille subbasins, and both cross the Coos Bay-Frontal Pacific Ocean and North Fork Coquille River fifth-field watersheds. In addition, the comparison portion of the proposed route would cross the Coquille (Middle Main) River watershed, and the Blue Ridge Alternative would cross (along the border) the South Fork Coos River watershed (table 3.4.2-1). None of the fifth-field watersheds crossed by the Blue Ridge Alternative or comparison portion of the proposed route are identified in the BLM Coos Bay District RMP as Key Watersheds.

For an in-depth discussion of surface water issues associated with the Pacific Connector pipeline, see section 4.4.2.2 of the FEIS. The following subsections provide a summary of key metrics between the Blue Ridge Alternative and comparison portion of the proposed route.

TABLE 3.4.2-1

Subbasins and Fifth-Field Watershed Crossed by the Pacific Connector Pipeline, by Alternative

	Fifth-Field Watershed		
Subbasin	**Name**	**HUC**	**Miles Crossed a/**
Proposed Route (Comparison)			
Coos	Coos Bay- Frontal Pacific Ocean	1710030403	10.4
Coquille	Coquille (Middle Main) River	1710030505	2.0
	North Fork Coquille River	1710030504	1.9
		Total	**14.4**
Blue Ridge Alternative			
Coos	Coos Bay- Frontal Pacific Ocean	1710030403	6.7
	South Fork Coos River	1710030401	2.0
Coquille	North Fork Coquille River	1710030504	5.2
		Total	**14.0**

a/ Mileages are rounded to nearest tenth of a mile.

3.4.2.1 Water Quality Limited Waters

Table 3.4.2.1-1 presents the streams listed as water quality limited that are crossed by the comparison portion of the proposed route and Blue Ridge Alternative. The comparison portion of the proposed route would cross five waterbodies where water quality is limited and a TMDL is required, including one major (greater than 100-feet wide) crossing at Catching Slough. The Blue Ridge Alternative would cross one waterbody listed with limited water quality.

TABLE 3.4.2.1-1

ODEQ Water Quality Limited Streams Crossed by the Pacific Connector Pipeline, by Alternative

Waterbody	Crossing Method	FERC Classification a/	Stream Type	Category 4 or 5 Listing
Proposed Route (Comparison)				
Coast Range Ecoregion, Coos Subbasin Coos Bay-Frontal Pacific Ocean Fifth-field Watershed, Coos County				
Stock Slough	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year-Round - 5
Catching Slough	Conventional Bore	Major	Perennial	Fecal Coliform/Year-Round - 5
Ross Slough	Dry Open-Cut	Minor	Perennial	Temperature/Year-Round - 5
Catching Creek	Dry Open-Cut	Minor	Perennial	Fecal Coliform/Year-Round - 5
Coast Range Ecoregion, Coquille Subbasin, Coquille River Fifth-field Watershed, Coos County				
Cunningham Creek	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year Round - 5; Dissolved Oxygen/Year Round – 5; Habitat Modification – 4C; Flow Modification – 4C
Blue Ridge Alternative				
Coast Range Ecoregion, Coos Subbasin Coos Bay-Frontal Pacific Ocean Fifth-field Watershed, Coos County				
Stock Slough	Dry Open-Cut	Intermediate	Perennial	Fecal Coliform/Year-Round - 5

a/ Minor waterbody includes all waterbodies less than or equal to 10 feet wide at the water's edge at the time of construction; intermediate waterbody includes all waterbodies greater than 10 feet wide but less than or equal to 100 feet wide at the water's edge at the time of construction; and major waterbody includes all waterbodies greater than 100 feet wide at the water's edge at the time of construction.

3.4.2.2 Drinking Water Source Areas

Both the Blue Ridge Alternative and comparison portion of the proposed route would cross one drinking water source area for the City of Myrtle Point (table 3.4.2.2-1).

TABLE 3.4.2.2-1

Surface Water Public DWSAs Crossed by the Pacific Connector Pipeline, by Alternative

Starting Milepost	Ending Milepost	County	Drinking Water Source Area	Public Drinking Water System ID	Source Water
Proposed Route (Comparison)					
19.86	21.8	Coos	City of Myrtle Point	4100551	N. F. Coquille River
Blue Ridge Alternative					
20.10	25.35	Coos	City of Myrtle Point	4100551	N. F. Coquille River

3.4.2.3 Points of Diversion

Table 3.4.2.3-1 describes the surface water points of diversion near the proposed route and Blue Ridge Alternative. Both the Blue Ridge Alternative and comparison portion of the proposed route would be within 150 feet of two surface water points of diversion. Both of the diversions near the proposed route are for domestic water usage, and one of them would be within the construction right-of-way. The points of diversion near the Blue Ridge Alternative are both used for irrigation, and at least 75 feet from construction activities.

TABLE 3.4.2.3-1

Points of Diversion within 150 feet of the Pacific Connector Pipeline Construction Work Area, by Alternative

Water Right Type	Water Right Owner	Nearest MP	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion	Number of Water Rights
Proposed Route (Comparison)									
Surface Water	Private	12.07	53679	Stream	Unnamed Stream	Domestic (including Lawn and Garden)	79.83	n/a	1
		13.80	36042	Spring	A spring	Domestic	0.00	Construction Right-of-Way	1
								Surface Water Total	***2***
								Grand Total	**2**
Blue Ridge Alternative									
Surface Water	Private	15.14	33911	Stream	Stock Slough	Irrigation	75.25	n/a	1
		15.32	33911	Stream	Catching Slough Trib.	Irrigation	99.42	n/a	1
								Surface Water Total	**2**
								Grand Total	**2**

3.4.2.4 Floodplains

Table 3.4.2.4-1 lists the floodplain areas crossed by the pipeline routes by MP. The comparison portion of the proposed route would cross 2.3 miles of floodplain, while the Blue Ridge Alternative would cross 1 mile of floodplain zone. These areas are inundated by 100-year flooding.

TABLE 3.4.2.4-1

Floodplain Areas Crossed by the Pacific Connector Pipeline, by Alternative

Starting Milepost	Ending Milepost	Fifth-Field Watershed	Zone a/	Miles of Pipeline b/
Proposed Route (Comparison)				
11.29 R	8.8	Coos Bay-Frontal Pacific Ocean	A	1.6
10.1	10.4	Coos Bay-Frontal Pacific Ocean	A	0.3
11	11.4	Coos Bay-Frontal Pacific Ocean	A	0.4
11.8	11.9	Coos Bay-Frontal Pacific Ocean	A	<0.1
15.7	15.7	Coos Bay-Frontal Pacific Ocean	A	<0.1
		Total		**2.3**
Blue Ridge Alternative				
11.3 R	11.6 R	Coos Bay-Frontal Pacific Ocean	A	0.3
11.7 R	12.06	Coos Bay-Frontal Pacific Ocean	A	0.3
15.0	15.4	Coos Bay-Frontal Pacific Ocean	A	0.4
24.4	24.4	North Fork Coquille River	A	<0.1
		Total		**1.0**

a/ Zone A: An area inundated by 100-year flooding, for which no Base Flood Elevations have been determined.
b/ Mileages are rounded to the nearest tenth of a mile; values less than 0.1 mile are noted as <0.1. Column may not sum correctly due to rounding.

3.4.2.5 Surface Water Body Crossings

Temporary Bridges at Stream Crossings

No temporary bridges would be used at stream crossings for either route.

Minor or Intermediate Waterbody Crossings

The Blue Ridge Alternative would cross one waterbody classified as intermediate and 7 minor waterbodies. The comparison portion of the proposed route would include one major waterbody crossing, 9 intermediate crossings, and 56 minor waterbody crossings. See section 4.4.2.2 of the FEIS for a description of waterbody crossing methods.

Neither the Blue Ridge Alternative nor comparison portion of the proposed route would have crossings identified as a Level 2 scour hazard.

3.4.2.6 General Pipeline Construction Impacts on Waterbodies and Proposed Mitigation Measures

For the complete discussion of construction impacts on waterbodies and proposed mitigation measures, see section 4.4.2.2 of the FEIS. The discussion in section 4.4.2.2 of the FEIS is applicable to waterbodies crossed by the Blue Ridge Alternative and comparison portion of the proposed route.

3.4.3 Wetlands

Table 3.4.3-1 summarizes the acres of impact that would occur to the general wetland types found along the comparison portion of the proposed route and Blue Ridge Alternative. In total, the comparison portion of the proposed route would disturb 34.5 acres of wetlands, and the Blue Ridge Alternative would disturb 13 acres. No wetlands affected by the Blue Ridge Alternative would require long-term restoration, and 0.3 acre would need long-term restoration for the comparison portion of the proposed route.

TABLE 3.4.3-1

Summary of Wetland Impacts along the Pacific Connector Pipeline, by Alternative

Wetland Type	Total Construction Disturbance in Wetland (acres)	Wetland Vegetation Affected Requiring Long-Term Restoration (acres)
Proposed Route (Comparison)		
Palustrine unconsolidated bottom and aquatic beds	0.0	0.0
Palustrine emergent wetlands	32.3	0.0
Palustrine forested wetlands	0.9	0.3
Palustrine scrub-shrub wetlands	0.0	0.0
Riverine wetlands	1.3	0.0
Estuarine	0.0	0.0
Lake	0.0	0.0
Total Wetland Impact	**34.5**	**0.3**
Blue Ridge Alternative		
Palustrine unconsolidated bottom and aquatic beds	0.0	0.0
Palustrine emergent wetlands	12.9	<0.1 a/
Palustrine forested wetlands	0.0	0.0
Palustrine scrub-shrub wetlands	0.0	0.0
Riverine wetlands	0.1	0.0
Estuarine	0.0	0.0
Lake	0.0	0.0
Total Wetland Impact	**13.0**	**0.0**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre.
a/ 0.06 acre of palustrine emergent wetland would be filled to install MLV#2 on the Blue Ridge Alternative.

3.5 UPLAND VEGETATION AND TIMBER

3.5.1 Upland Vegetation

Tables 3.5.1-1a&b, 3.5.1-2a&b, 3.5.1-3a&b, and 3.5.1-4a&b detail the impacts on vegetation between the comparison portion of the proposed route and the Blue Ridge Alternative. Of the total 14.4 miles for the comparison portion of the proposed route, 13.6 miles (94 percent) are considered vegetated, primarily forest land (table 3.5.1-1a). The Blue Ridge Alternative is vegetated for 13 miles (93 percent), also primarily forest land (table 3.5.1-1b).

Construction of the comparison portion of the proposed route would impact approximately 218 acres of vegetation, while the Blue Ridge Alternative would impact 227 acres (tables 3.5.1-2a and 3.5.1-2b). Operation of the project would impact 64 acres along the comparison portion of the proposed route, and 68 acres along the Blue Ridge Alternative (tables 3.5.1-3a and 3.5.1-3b).

Approximately 17 acres of interior forests would be directly affected, and another 201 acres would be indirectly affected (i.e., would be within 100 meters of newly created edges) by construction of the comparison portion of the proposed route (table 3.5.1-4a). For the Blue Ridge Alternative, 111 acres of interior forests would be directly affected, and 787 acres would be indirectly affected by construction (table 3.5.1-4b).

TABLE 3.5.1-1a

Vegetation Cover Types Crossed by the Pacific Connector Pipeline – Proposed Route (Comparison)

General Vegetation Type	Mapped Vegetation Category	Late Successional or Old-Growth Forest Crossed a/ (miles)	Percent of Total Late Successional or Old-Growth Forest a/	Mid-Seral Forest Crossed b/ (miles)	Percent of Mid-Seral Forest b/	Clearcut/ Regenerating Forest Crossed c/ (miles)	Percent of Clearcut/ Regenerating Forest c/	Total Miles	Percent of Total Vegetation Type
Forest-Woodland	Douglas-fir-W. Hemlock-W. Red-Cedar Forest	-	-	1.5	42.3	0.3	4.0	1.8	12.7
	Douglas-Fir-Mixed Deciduous Forest	-	-	-	-	-	-	-	-
	Alder-Cottonwood	-	-	-	-	-	-	-	-
	Mixed Conifer/Mixed Deciduous Forest	0.4	100.0	2.1	57.7	6.9	96.0	9.4	65.4
	Shasta Red Fir – Mountain Hemlock Forest	-	-	-	-	-	-	-	-
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	-	-	-	-	-	-	-	-
	Douglas-fir Dominant-Mixed Conifer Forest	-	-	-	-	-	-	-	-
	Ponderosa Pine/White Oak Forest and Woodland	-	-	-	-	-	-	-	-
	Ponderosa Pine Forest and Woodland	-	-	-	-	-	-	-	-
	Oregon White Oak Forest	-	-	-	-	-	-	-	-
	Western Juniper Woodland	-	-	-	-	-	-	-	-
	Ponderosa Pine/Western Juniper Woodland	-	-	-	-	-	-	-	-
	Subtotal	**0.4**	**0.0**	**3.7**	**0.0**	**7.2**	**0.0**	**11.3**	**78.1**
Grasslands-Shrubland	Sagebrush Steppe	-	-	-	-	-	-	-	-
	Shrublands	-	-	-	-	-	-	-	-
	Grasslands (West of Cascades)	-	-	-	-	-	-	-	-
	Grasslands (East of Cascades)/Forest-Grassland Mosaic	-	-	-	-	-	-	-	-
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Wetland / Riparian	Palustrine Forest	-	-	-	-	0.1	-	0.1	0.6
	Palustrine Shrub	-	-	-	-	-	-	-	-
	Palustrine Emergent	-	-	-	-	-	-	1.8	12.4
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**1.9**	**13.0**
Agriculture	Agriculture	-	-	-	-	-	-	0.4	2.6
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**	**2.6**
Developed / Barren	Urban	-	-	-	-	-	-	0.1	0.5
	Industrial	-	-	-	-	-	-	-	-
	Beaches	-	-	-	-	-	-	-	-
	Roads	-	-	-	-	-	-	0.7	4.8
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**5.3**
Open Water	Rivers and Streams	-	-	-	-	-	-	0.1	1.0
	Ditches and Canals	-	-	-	-	-	-	<1	0.1
	Palustrine Unconsolidated Bottom	-	-	-	-	-	-	-	-
	Bays and Estuaries	-	-	-	-	-	-	-	-

TABLE 3.5.1-1a

Vegetation Cover Types Crossed by the Pacific Connector Pipeline – Proposed Route (Comparison)

General Vegetation Type	Mapped Vegetation Category	Late Successional or Old-Growth Forest Crossed a/ (miles)	Percent of Total Late Successional or Old-Growth Forest a/	Mid-Seral Forest Crossed b/ (miles)	Percent of Mid-Seral Forest b/	Clearcut/ Regenerating Forest Crossed c/ (miles)	Percent of Clearcut/ Regenerating Forest c/	Total Miles	Percent of Total Vegetation Type
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**1.0**
	Project Total	**0.4**	**0.0**	**3.7**	**0.0**	**7.2**	**0.0**	**14.4**	**100.0**
	Percent of Project Total	**3.2**		**25.4**		**50.2**			

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).
General: Mileages may not sum correctly due to rounding. Mileages are rounded to nearest tenth of a mile; values less than 0.1 are shown as "<0.1".

TABLE 3.5.1-1b

Vegetation Cover Types Crossed by the Pacific Connector Pipeline – Blue Ridge Alternative

General Vegetation Type	Mapped Vegetation Category	Late Successional or Old-Growth Forest Crossed a/ (miles)	Percent of Total Late Successional or Old-Growth Forest a/	Mid-Seral Forest Crossed b/ (miles)	Percent of Mid-Seral Forest b/	Clearcut/ Regenerating Forest Crossed c/ (miles)	Percent of Clearcut/ Regenerating Forest c/	Total Miles	Percent of Total Vegetation Type
Forest-Woodland	Douglas-fir-W. Hemlock-W. Red-Cedar Forest	-	-	0.8	26.2	0.2	3.5	1.0	7.1
	Douglas-Fir-Mixed Deciduous Forest	-	-	-	-	-	-	-	-
	Alder-Cottonwood	-	-	-	-	-	-	-	-
	Mixed Conifer/Mixed Deciduous Forest	2.9	100.0	2.2	73.9	5.3	96.5	10.5	74.8
	Shasta Red Fir – Mountain Hemlock Forest	-	-	-	-	-	-	-	-
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	-	-	-	-	-	-	-	-
	Douglas-fir Dominant-Mixed Conifer Forest	-	-	-	-	-	-	-	-
	Ponderosa Pine/White Oak Forest and Woodland	-	-	-	-	-	-	-	-
	Ponderosa Pine Forest and Woodland	-	-	-	-	-	-	-	-
	Oregon White Oak Forest	-	-	-	-	-	-	-	-
	Western Juniper Woodland	-	-	-	-	-	-	-	-
	Ponderosa Pine/Western Juniper Woodland	-	-	-	-	-	-	-	-
	Subtotal	**2.9**	**0.0**	**3.0**	**0.0**	**5.5**	**0.0**	**11.5**	**81.8**
Grasslands-Shrubland	Sagebrush Steppe	-	-	-	-	-	-	-	-
	Shrublands	-	-	-	-	-	-	-	-
	Grasslands (West of Cascades)	-	-	-	-	-	-	-	-
	Grasslands (East of Cascades)/Forest-Grassland Mosaic	-	-	-	-	-	-	-	-
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Wetland / Riparian	Palustrine Forest	-	-	-	-	-	-	-	-
	Palustrine Shrub	-	-	-	-	-	-	-	-
	Palustrine Emergent	-	-	-	-	-	-	0.8	6.0
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**6.0**
Agriculture	Agriculture	-	-	-	-	-	-	0.7	4.9
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.7**	**4.9**
Developed / Barren	Urban	-	-	-	-	-	-	-	-
	Industrial	-	-	-	-	-	-	-	-
	Beaches	-	-	-	-	-	-	-	-
	Roads	-	-	-	-	-	-	1.0	7.4
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.0**	**7.4**

TABLE 3.5.1-1b

Vegetation Cover Types Crossed by the Pacific Connector Pipeline – Blue Ridge Alternative

General Vegetation Type	Mapped Vegetation Category	Late Successional or Old-Growth Forest Crossed a/ (miles)	Percent of Total Late Successional or Old-Growth Forest a/	Mid-Seral Forest Crossed b/ (miles)	Percent of Mid-Seral Forest b/	Clearcut/ Regenerating Forest Crossed c/ (miles)	Percent of Clearcut/ Regenerating Forest c/	Total Miles	Percent of Total Vegetation Type
Open Water	Rivers and Streams	-	-	-	-	-	-	<1	0.1
	Ditches and Canals	-	-	-	-	-	-	-	-
	Palustrine Unconsolidated Bottom	-	-	-	-	-	-	-	-
	Bays and Estuaries	-	-	-	-	-	-	-	-
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	Project Total	**2.9**	**0.0**	**3.0**	**0.0**	**5.5**	**0.0**	**14.0**	**100.0**
	Percent of Project Total	**20.7**		**21.6**		**39.5**			

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).
General: Mileages may not sum correctly due to rounding. Mileages are rounded to nearest tenth of a mile; values less than 0.1 are shown as “<0.1”.).

TABLE 3.5.1-2a

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline(acres) – Proposed Route (Comparison)

			Pipeline Facilities								Subtotals					
General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities	Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	17	-	3	-	-	-	-	-	-	20	6	26	*15.0*	*11.4*
		C-R	3	-	2	-	-	-	-	-						
	Douglas-fir – Mixed Deciduous Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Alder-Cottonwood	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Mixed Conifer/Mixed Deciduous Forest	L-O	5	-	1	-	-	-	-	-						
		M-S	25	-	4	1	-	-	-	-	7	31	110	148	*85.0*	*64.7*
		C-R	80	-	30	<1	-	-	-	<1						
	Shasta Red Fir – Mountain Hemlock Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Ponderosa Pine/White Oak Forest and Woodland	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Ponderosa Pine Forest and Woodland	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Oregon White Oak Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Western Juniper Woodland	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Ponderosa Pine/Western Juniper Woodland	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						

TABLE 3.5.1-2a

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline(acres) – Proposed Route (Comparison)

General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Pipeline Facilities: Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities	Subtotals: Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*
Subtotal Forest-Woodland by Age Class		*L-O*	*5*	-	*1*	-	-	-	-	-					*3.9*	
		M-S	*43*	-	*8*	*1*	-	-	-	-	*7*	*51*	*116*	*174*	*29.4*	*76.2*
		C-R	*84*	-	*33*	*<1*	-	-	-	*<1*					*66.7*	
	Subtotal Forest-Woodland		131	-	-	1	-	-	-	<1	7	51	116	174	-	-
	Percent of All Forest-Woodland		*75.5*	-	*23.9*	*0.6*	-	-	-	*0.0*	*3.9*	*29.4*	*66.7*	*100.0*	-	-
Grasslands-Shrubland	Sagebrush Steppe	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Shrublands	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Grasslands (West of Cascades)	n/a	-	-	<1	-	-	-	-	-	-	-	-	<1	*0.3*	*0.1*
	Grasslands (East of Cascades)	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Grasslands-Shrubland		-	-	<1	-	-	-	-	-	-	-	-	<1	*0.3*	*0.1*
Wetland / Riparian	Palustrine Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	<1	<1	*1.7*	*0.4*
		C-R	<1	-	-	-	-	-	-	-						
	Palustrine Shrub	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Palustrine Emergent	n/a	20	-	12	-	-	-	-	-	-	-	-	33	*59.8*	*14.3*
	Subtotal Wetland / Riparian		21	-	12	-	-	-	-	-	-	-	<1	34	*61.5*	*14.7*
Agriculture	Agriculture	n/a	5	-	6	<1	-	-	-	-	-	-	-	10	*19.0*	*4.5*
	Subtotal Agriculture		5	-	6	<1	-	-	-	-	-	-	-	10	*19.0*	*4.5*
Developed / Barren	Urban	n/a	<1	-	<1	-	-	-	-	-	-	-	-	1	*2.0*	*0.5*
	Industrial	n/a	-	-	<1	-	-	-	-	-	-	-	-	<1	*0.0*	*0.0*
	Beaches	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Roads	n/a	5	-	2	<1	-	-	-	-	-	-	-	8	*13.8*	*3.3*
	Subtotal Developed / Barren		6	-	2	<1	-	-	-	-	-	-	-	9	*15.8*	*3.8*
Open Water	Rivers and Streams	n/a	2	-	<1	-	-	-	-	-	-	-	-	2	*3.1*	*0.7*
	Ditches and Canals	n/a	<1	-	<1	-	-	-	-	-	-	-	-	<1	*0.3*	*0.1*
	Palustrine Unconsolidated Bottom	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bays and Estuaries	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Open Water		2	-	<1	-	-	-	-	-	-	-	-	2	*3.3*	*0.8*
	Subtotal Non-Forest		34	-	20	<1	-	-	-	-	-	-	<1	54	*100.0*	*23.8*
	Percent of All Non-Forest		*62.4*	-	*37.5*	*0.0*	-	-	-	-	-	-	*1.7*	*100.0*	-	*43.7*
Project Total		n/a	165	-	62	1	-	-	-	<1	7	51	117	229	-	*100.0*
Percent of Pipeline Facilities		n/a	*72.4*	-	*27.2*	*0.5*	-	-	-	*0.0*	*3.0*	*22.4*	*51.2*	*100.0*	-	-

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

TABLE 3.5.1-2a

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline(acres) – Proposed Route (Comparison)

			Pipeline Facilities								Subtotals					
General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities	Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.
c/ The "Clearcut or Regenerating" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.
Note: Aboveground facilities not included in overall total (occur within construction right-of-way impacts)

TABLE 3.5.1-2b

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline(acres) – Blue Ridge Alternative

			Pipeline Facilities								Subtotals					
General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities	Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	9	-	1	1	-	-	-	-	-	11	3	14	*6.9*	*5.8*
		C-R	2	-	<1	<1	-	-	-	-						
	Douglas-fir – Mixed Deciduous Forest	L-O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		M-S	-	-	-	-	-	-	-	-						
		C-R	-	-	-	-	-	-	-	-						
	Alder-Cottonwood	L-O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		M-S	-	-	-	-	-	-	-	-						
		C-R	-	-	-	-	-	-	-	-						
	Mixed Conifer/Mixed Deciduous Forest	L-O	34	-	7	11	-	-	-	-						
		M-S	26	-	6	9	-	-	-	-	51	41	97	189	*93.1*	*77.6*
		C-R	61	-	13	23	-	-	-	-						
	Shasta Red Fir – Mountain Hemlock Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Ponderosa Pine/White Oak Forest and Woodland	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Ponderosa Pine Forest and Woodland	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Oregon White Oak Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Western Juniper Woodland	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Ponderosa Pine/Western Juniper Woodland	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						

TABLE 3.5.1-2b

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline(acres) – Blue Ridge Alternative

General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Pipeline Facilities: Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities	Subtotals: Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*
Subtotal Forest-Woodland by Age Class		*L-O*	*34*	-	*7*	*11*	-	-	-	-					*25.1*	
		M-S	*35*	-	*7*	*10*	-	-	-	-	*51*	*52*	*100*	*203*	*25.4*	*83.4*
		C-R	*63*	-	*14*	*23*	-	-	-	-					*49.4*	
	Subtotal Forest-Woodland		132	-	28	44	-	-	-	-	51	52	100	203	-	-
	Percent of All Forest-Woodland		*64.7*	-	*13.7*	*21.6*	-	-	-	-	*25.1*	*25.4*	*49.4*	*100.0*	-	-
Grasslands-Shrubland	Sagebrush Steppe	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Shrublands	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Grasslands (West of Cascades)	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Grasslands (East of Cascades)	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Grasslands-Shrubland		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wetland / Riparian	Palustrine Forest	L-O	-	-	-	-	-	-	-	-						
		M-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		C-R	-	-	-	-	-	-	-	-						
	Palustrine Shrub	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Palustrine Emergent	n/a	10	-	3	<1	-	-	-	<1	-	-	-	13	*31.7*	*5.3*
	Subtotal Wetland / Riparian		10	-	3	<1	-	-	-	<1	-	-	-	13	*31.7*	*5.3*
Agriculture	Agriculture	n/a	8	-	3	<1	-	-	-	-	-	-	-	11	*27.0*	*4.5*
	Subtotal Agriculture		8	-	3	<1	-	-	-	-	-	-	-	11	*27.0*	*4.5*
Developed / Barren	Urban	n/a	-	-	-	-	-	-	-	-	-	-	-	<1	*0.1*	*0.0*
	Industrial	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Beaches	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Roads	n/a	12	-	3	1	-	-	-	-	-	-	-	17	*40.8*	*6.8*
	Subtotal Developed / Barren		12	-	3	1	-	-	-	-	-	-	-	17	*40.8*	*6.8*
Open Water	Rivers and Streams	n/a	<1	-	<1	-	-	-	-	-	-	-	-	<1	*0.4*	*0.1*
	Ditches and Canals	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Palustrine Unconsolidated Bottom	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bays and Estuaries	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Open Water		<1	-	<1	-	-	-	-	-	-	-	-	<1	*0.4*	*0.1*
	Subtotal Non-Forest		30	-	9	1	-	-	-	<1	-	-	-	41	*100.0*	*16.6*
	Percent of All Non-Forest		*73.7*	-	*22.8*	*3.5*	-	-	-	*0.0*	-	-	-	*100.0*	-	-
Project Total		n/a	161	-	37	45	-	-	-	<1	51	52	100	244	-	-
Percent of Pipeline Facilities		n/a	*66.2*	-	*15.2*	*18.6*	-	-	-	*0.0*	*20.9*	*21.2*	*41.2*	*100.0*	-	-

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

TABLE 3.5.1-2b

Summary of Construction-Related Disturbance to Vegetation by the Pacific Connector Pipeline(acres) – Blue Ridge Alternative

			Pipeline Facilities								Subtotals					
General Vegetation Type	Mapped Vegetation Category Type	Forest Stand by Age a/,b/,c/	Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities	Subtotal Late Successional – Old Growth	Subtotal Mid-Seral	Subtotal Clearcut or Regenerating	Subtotal by Habitat Type	*Percent of Vegetation Type*	*Percent of Total Vegetation Type*

b/ The “Mid-Seral” category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.
c/ The “Clearcut or Regenerating” category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.
Note: Aboveground facilities not included in overall total (occur within construction right-of-way impacts)

TABLE 3.5.1-3a

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline – Proposed Route (Comparison)

Mapped Vegetation Category Type		Forest Stand by Age b/,c/,d/	Pipeline Facilities (acres a/): *30-foot Maintenance Corridor*	Pipeline Facilities (acres a/): Permanent Access Roads	Pipeline Facilities (acres a/): Subtotal LSOG	Pipeline Facilities (acres a/): Subtotal Mid-Seral Forest	Pipeline Facilities (acres a/): Subtotal Clearcut / Regenerating Forest	Pipeline Facilities (acres a/): Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Aboveground Facilities (acres a/): BVA #2	Total Operation Impacts by Vegetation Type e/
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	-	-							
		M-S	6	-	-	6	1	7	9	-	7
		C-R	1	-					2		
	Douglas-fir – Mixed Deciduous Forest	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R/	-	-					-		
	Alder-Cottonwood	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
	Mixed Conifer/Mixed Deciduous Forest	L-O	2	-					3	-	
		M-S	8	-	2	8	25	34	13	-	35
		C-R	25	-					42	<1	
	Shasta Red Fir – Mountain Hemlock Forest	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
	Ponderosa Pine/White Oak Forest and Woodland	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
	Ponderosa Pine Forest and Woodland	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
	Oregon White Oak Forest	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
	Western Juniper Woodland	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
	Ponderosa Pine/Western Juniper Woodland	L-O	-	-					-		
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-		
Subtotal Forest-Woodland by Age Class		*L-O*	*2*						*3*	-	-
		M-S	*13*		2	13	26	41	*22*	-	-
		C-R	*26*						*44*	*<1*	*26*
Subtotal Forest-Woodland			41		2	13	26	41	69	<1	41
Grasslands-Shrubland	Sagebrush Steppe	n/a	-	-	-	-	-	-	-	-	-
	Shrublands	n/a	-	-	-	-	-	-	-	-	-
	Grasslands (West of the Cascades)	n/a	-	-	-	-	-	-	-	-	-
	Grasslands (East of the Cascades)	n/a	-	-	-	-	-	-	-	-	-
Subtotal Grasslands-Shrubland			-	-	-	-	-	-	-	-	-

TABLE 3.5.1-3a

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline – Proposed Route (Comparison)

Mapped Vegetation Category Type		Forest Stand by Age b/,c/,d/	Pipeline Facilities (acres a/): *30-foot Maintenance Corridor*	Pipeline Facilities (acres a/): Permanent Access Roads	Pipeline Facilities (acres a/): Subtotal LSOG	Pipeline Facilities (acres a/): Subtotal Mid-Seral Forest	Pipeline Facilities (acres a/): Subtotal Clearcut / Regenerating Forest	Pipeline Facilities (acres a/): Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Aboveground Facilities (acres a/): BVA #2	Total Operation Impacts by Vegetation Type e/
Wetland/ Riparian	-	L-O	-	-					-		
		M-S	-	-	-	-	<1	<1	-	-	<1
		C-R	<1	-					*<1*		
	Palustrine Shrubland	n/a	-	-	-	-	-	-	-	-	-
	Palustrine Emergent	n/a	6	-	-	-	-	6	*11*	-	6
		Subtotal Wetland/Riparian	7	-	-	-	-	-	*11*	-	7
Agriculture	Agriculture	n/a	1	-	-	-	-	1	*2*	-	1
		Subtotal Agriculture	1	-	-	-	-	-	*2*	-	1
Developed / Barren	Urban	n/a	<1	-	-	-	-	<1	*<1*	-	<1
	Industrial	n/a		-	-	-	-	-	-	-	-
	Beaches	n/a		-	-	-	-	-	-	-	-
	Roads	n/a	2	-	-	-	-	2	*4*	-	2
		Subtotal Developed / Barren	3	-	-	-	-	-	*4*	-	3
Open Water	Rivers and Streams	n/a	<1	-	-	-	-	<1	*<1*	-	<1
	Ditches and Canals	n/a	<1	-	-	-	-	<1	*<1*	-	<1
	Palustrine Unconsolidated Bottom	n/a	-	-	-	-	-	-	*<1*	-	-
	Bays and Estuaries	n/a	-	-	-	-	-	-	-	-	-
		Subtotal Open Water	<1	-	-	-	-	-	-	-	<1
		Subtotal Non-Forest	11	-	-	-	<1	11	*19*	-	11
		Project Total	52	-	2	13	26	52	*87*	<1	52

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, 50-foot permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.

b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

d/ The "Clearcut or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years).

e/ Total by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves are located within the 30-foot maintenance corridor).

General: If percentages were less than 1/100ths, they were not included in the table.

Columns and rows do not necessarily sum correctly due to rounding.

Acres of impacts to non-vegetated areas are included within this table for consistency in values reported within this EIS.

TABLE 3.5.1-3b

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline– Blue Ridge Alternative

			Pipeline Facilities (acres a/)							Aboveground Facilities (acres a/)	
Mapped Vegetation Category Type		Forest Stand by Age b/,c/,d/	*30-foot Maintenance Corridor*	Permanent Access Roads	Subtotal LSOG	Subtotal Mid-Seral Forest	Subtotal Clearcut / Regenerating Forest	Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Blue Ridge Block Valve	Total Operation Impacts by Vegetation Type e/
Forest-Woodland	Douglas-fir-W. Hemlock-W. Redcedar Forest	L-O	-	-					-	-	
		M-S	3	-	-	3	1	4	5	-	4
		C-R	1	-					1	-	
	Douglas-fir – Mixed Deciduous Forest	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R/	-	-					-	-	
	Alder-Cottonwood	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
	Mixed Conifer/Mixed Deciduous Forest	L-O	11	-					18	-	
		M-S	8	-	11	8	19	38	13	-	38
		C-R	19	-					32	-	
	Shasta Red Fir – Mountain Hemlock Forest	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
	Douglas-fir-White Fir/Tanoak-Madrone Mixed Forest	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
	Douglas-fir Dominant-Mixed Conifer Forest	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
	Ponderosa Pine/White Oak Forest and Woodland	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
	Ponderosa Pine Forest and Woodland	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
	Oregon White Oak Forest	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
	Western Juniper Woodland	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
	Ponderosa Pine/Western Juniper Woodland	L-O	-	-					-	-	
		M-S	-	-	-	-	-	-	-	-	-
		C-R	-	-					-	-	
Subtotal Forest-Woodland by Age Class		*L-O*	*11*	-					*18*	-	*11*
		M-S	*11*	-	11	11	20	42	*18*	-	*11*
		C-R	*20*	-					*34*	-	*20*
Subtotal Forest-Woodland			42	-	11	11	20	42	69	-	42
Grasslands -Shrubland	Sagebrush Steppe	n/a	-	-	-	-	-	-	-	-	-
	Shrublands	n/a	-	-	-	-	-	-	-	-	-
	Grasslands (West of the Cascades)	n/a	-	-	-	-	-	-	-	-	-
	Grasslands (East of the Cascades)	n/a	-	-	-	-	-	-	-	-	-
Subtotal Grasslands-Shrubland											

TABLE 3.5.1-3b

Summary of Operation-Related Disturbance to Vegetation by the Pacific Connector Pipeline– Blue Ridge Alternative

Mapped Vegetation Category Type		Forest Stand by Age b/,c/,d/	Pipeline Facilities (acres a/): *30-foot Maintenance Corridor*	Pipeline Facilities (acres a/): Permanent Access Roads	Pipeline Facilities (acres a/): Subtotal LSOG	Pipeline Facilities (acres a/): Subtotal Mid-Seral Forest	Pipeline Facilities (acres a/): Subtotal Clearcut / Regenerating Forest	Pipeline Facilities (acres a/): Subtotal Pipeline Facilities By Vegetation Type	Permanent Easement (50-foot)	Aboveground Facilities (acres a/): Blue Ridge Block Valve	Total Operation Impacts by Vegetation Type e/
Wetland/ Riparian	Palustrine Forest	L-O	-	-					*-*	-	
		M-S	-	-	-	-	-	-	*-*	-	-
		C-R	-	-					*-*	-	
	Palustrine Shrubland	n/a	-	-	-	-	-	-	*-*	-	-
	Palustrine Emergent	n/a	3	-	-	-	-	3	*5*	<1	3
	Subtotal Wetland/Riparian		3	-	-	-	-	3	*5*	<1	3
Agriculture	Agriculture	n/a	3	-	-	-	-	3	*4*	-	-
	Subtotal Agriculture		3	-	-	-	-	3	*4*	-	-
Developed / Barren	Urban	n/a	-	-	-	-	-	-	*-*	-	-
	Industrial	n/a	-	-	-	-	-	-	*-*	-	-
	Beaches	n/a	-	-	-	-	-	-	*-*	-	-
	Roads	n/a	4	-	-	-	-	4	*6*	-	-
	Subtotal Developed / Barren		4	-	-	-	-	4	*6*	-	-
Open Water	Rivers and Streams	n/a	<1	-	-	-	-	<1	*<1*	-	-
	Ditches and Canals	n/a	-	-	-	-	-	-	*-*	-	-
	Palustrine Unconsolidated Bottom	n/a	-	-	-	-	-	-	*-*	-	-
	Bays and Estuaries	n/a	-	-	-	-	-	-	*-*	-	-
	Subtotal Open Water		<1	-	-	-	-	<1	*<1*	-	-
	Subtotal Non-Forest		9	-	-	-	-	9	*16*	<1	9
	Project Total		51	-	-	-	-	51	*85*	<1	51

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").
a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, 50-foot permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.
b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.
c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.
d/ The "Clearcut or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years).
e/ Total by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves are located within the 30-foot maintenance corridor).
General: If percentages were less than 1/100ths, they were not included in the table.
Columns and rows do not necessarily sum correctly due to rounding.
Acres of impacts to non-vegetated areas are included within this table for consistency in values reported within this EIS.

TABLE 3.5.1-4a

Direct and Indirect Effects to Interior Forests from Construction of the Pacific Connector Pipeline – Proposed Route (Comparison)

Landowner	Land Use Allocation	Age Classes a/, b/, c/	Direct Effects to Interior Forest (acres): Construction Right-of-Way	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal / Pipe Yards	Total by Age Class	Total Direct Effects	Indirect Effects to Interior Forest (acres): *100 meter Buffer from Vegetation Removal*	Total Indirect Effects
BLM - Coos Bay	LSR - RO 261	L-O	-	-	-	-	-		-	
		M-S	-	-	-	-	-	-	-	-
		Regen	-	-	-	-	-		-	
	Unmapped LSR d/	L-O	-	-	-	-	-		-	
		M-S	-	-	-	-	-	-	-	-
		Regen	-	-	-	-	-		-	
	Other	L-O	-	-	-	-	-			
		M-S	1	<1	-	-	2	2	30	**32**
		Regen	-	<1	-	-	<1		<1	
	Subtotal - Coos Bay	*L-O*	-	-	-	-	-			
		M-S	1	<1	-	-	2	**2**	30	**32**
		Regen	-	<1	-	-	<1		<1	
		TOTAL	**1**	***<1***	-	-	**2**			
Other Landowners	None	L-O	2	<1	-	-	2		16	
		M-S	2	<1	-	-	2	**15**	36	**169**
		Regen	9	2	-	-	11		102	
Subtotal - Other Landowners		**TOTAL**	**12**	**3**	-	-	**15**		**154**	
Total Indirect/Direct Effects to Interior Forest		***L-O***	***2***	***<1***	-	-	***2***		***16***	
		M-S	***3***	***<1***	-	-	***4***	**17**	***66***	**201**
		Regen	***9***	***5***	-	-	***11***		***102***	
		TOTAL	**14**	**7**	-	-	**17**		**184**	

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1"").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

c/ The "Regenerating" category (Regen) describes those forest areas that are regenerating (tree age 5 to 40 years), but do not include recently harvested but regenerating forest (approximately 5 to 10 years – or early regenerating forest).

d/ Unmapped LSRs include occupied marbled murrelet stands and known owl activity centers that occur on NWFP Matrix lands. Areas identified as Unmapped LSRs include those provided by BLM (NSR 2012), as well as occupied marbled murrelet stands (delineated by BLM) that were not identified as unmapped LSRs (LSR3) by BLM but occur on Matrix lands.

TABLE 3.5.1-4b

Direct and Indirect Effects to Interior Forests from Construction of the Pacific Connector Pipeline – Blue Ridge Alternative

Landowner	Land Use Allocation	Age Classes a/, b/, c/	Direct Effects to Interior Forest (acres): Construction Right-of-Way	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal / Pipe Yards	Total by Age Class	Total Direct Effects	Indirect Effects to Interior Forest (acres): *100 meter Buffer from Vegetation Removal*	Total Indirect Effects
BLM - Coos Bay	LSR - RO 261	L-O	-	-	-	-	-	-	-	-
		M-S	-	-	-	-	-		-	
		Regen	-	-	-	-	-		-	
	Unmapped LSR d/	L-O	2	<1	3	-	5	5	25	**31**
		M-S	-	-	<1	-	<1		<1	
		Regen	<1	-	-	-	<1		<1	
	Other	L-O	18	4	5	-	26	67	153	**492**
		M-S	10	2	4	-	16		113	
		Regen	13	3	9	-	25		159	
	Subtotal - Coos Bay	*L-O*	*20*	*4*	*7*	-	*32*	**73**	*178*	**523**
		M-S	*10*	*2*	*4*	-	*16*		*113*	
		Regen	*13*	*3*	*9*	-	*25*		*159*	
		TOTAL	**43**	***9***	**20**	-	**73**		**450**	
Other Landowners	None	L-O	<1	<1	<1	-	2	**39**	24	**264**
		M-S	6	2	3	-	11		56	
		Regen	15	4	7	-	26		145	
Subtotal - Other Landowners		**TOTAL**	**22**	**7**	**10**	-	**39**		**225**	
Total Indirect/Direct Effects to Interior Forest		***L-O***	***21***	***5***	***8***	-	***34***	**111**	***203***	**787**
		M-S	***16***	***4***	***7***	-	***27***		***169***	
		Regen	***28***	***7***	***15***	-	***50***		***304***	
		TOTAL	**65**	**16**	**31**	-	**111**		**676**	

General: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1"").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

c/ The "Regenerating" category (Regen) describes those forest areas that are regenerating (tree age 5 to 40 years), but do not include recently harvested but regenerating forest (approximately 5 to 10 years – or early regenerating forest).

d/ Unmapped LSR includes only the known Occupied MAMU Stands and does not include any of the potentially occupied sites from 2015 survey data. These presumed occupied areas are displayed in figure 3.1-3**.** When BLM wildlife biologists have finished the occupied stand delineation process, there would be additional impacts to unmapped LSR on the Blue Ridge Alternative (see section 3.1.4.4).

3.5.2 Timber

3.5.2.1 Private Forest

The Blue Ridge Alternative would affect (timber removal) a total of 68 acres of private forestland and the proposed route comparison portion would affect 155 acres. In both cases, the majority of affected forestland (65 percent and 73 percent, respectively) includes areas previously harvested with current trees age 0 to 40 years. To mitigate effects to private forest landowners, Pacific Connector would negotiate an easement, which would account for the value of timber to be cleared within the construction right-of-way and TEWAs, lost timber production within the temporary and permanent easement, as well as potential operational easement effects. During public scoping, concerns were raised that the pipeline could interfere with forest operations or timber harvest and potential fire suppression efforts. These concerns are addressed in section 4.1.2.3 of the FEIS.

While the specific logging methods would not be determined until after a contractor has been selected, Pacific Connector expects that isolated areas may need helicopter logging. Currently, helicopter yarding is proposed for MP 18.1 to 19.3 along the comparison portion of the proposed route. No helicopter logging is proposed along the Blue Ridge Alternative at this time.

3.5.2.2 BLM Forest

Table 4.5.2.3-1 in the FEIS summarizes the estimated volume of timber that would be harvested on federally managed lands as part of right-of-way clearing. This includes 2,334 thousand board feet of timber from the BLM Coos Bay District. Further detail regarding timber harvest plans for the comparison portion of the proposed route and Blue Ridge Alternative are not available at this time. Pacific Connector is continuing to conduct timber cruises for the proposed route, and have not been completed for the Blue Ridge Alternative.

3.6 WILDLIFE AND AQUATIC SPECIES

3.6.1 Wildlife Resources

Tables 3.6.1-1a&b, 3.6.1-2a&b, 3.6.1-3a&b, and 3.6.1-4 detail the potential impacts of the comparison portion of the proposed route and Blue Ridge Alternative on wildlife resources. As shown in tables 3.6.1-1a and 3.6.1-1b, both the comparison portion of the proposed route and Blue Ridge Alternative would cross forest-woodland habitat types for the majority of their lengths (11.3 miles and 11.5 miles, respectively), as well as short distances of wetland/riparian habitat.

Construction of the comparison portion of the proposed route would impact approximately 174 acres of forest-woodland habitat, and 34 acres of wetland/riparian habitat (table 3.6.1-2a). The Blue Ridge Alternative would impact approximately 203 acres of forest-woodland habitat and 13 acres of wetland/riparian habitat during construction (table 3.6.1-2b). Operation of the comparison portion of the proposed route and the Blue Ridge Alternative would each impact 69 acres of forest-woodland habitat and less than one acre of wetland/riparian (tables 3.6.1-3a and 3.6.1-3b).

According to Oregon Department of Fish and Wildlife (ODFW) habitat categories, the comparison portion of the proposed route would remove 3 acres of irreplaceable, essential habitat that is limited (Category 1) during construction, and the Blue Ridge Alternative would remove 47 acres of Category 1 habitat during construction (table 3.6.1-4). Operational impact to Category 1 habitat would be 1 acre and 12 acres for the comparison portion of the proposed route and Blue Ridge Alternative, respectively (table 3.6.1-4). Pacific Connector is continuing to consult with ODFW regarding appropriate definition and application of the habitat categories identified in table 3.6.1-4.

TABLE 3.6.1-1a

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats – Proposed Route (Comparison)

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/ (miles)	Mid-Seral Forest Crossed b/ (miles)	Clearcut/ Regenerating Forest Crossed c/ (miles)	Total Miles	Percent of Total Project Mileage per Vegetation Type	Number of Species Associated
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	0.4	3.7	7.2	11.3	79.6	32 – Herpetofauna 113 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	-	-	-	-	-	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	-	-	-	-	-	35 – Herpetofauna 125 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	-	-	-	-	-	31 – Herpetofauna 124 – Birds 56 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	-	-	-	-	-	32 - Herpetofauna 113 – Birds 62 – Mammals
	Western Juniper and Mountain Mahogany Woodlands	-	-	-	-	-	19 - Herpetofauna 86 – Birds 34 – Mammals
	Subtotal	**0.4**	**3.7**	**7.2**	**11.3**	**79.6**	
Grasslands Shrubland	Shrub-steppe	-	-	-	-	-	22 – Herpetofauna 75 – Birds 46 – Mammals
	Westside Grasslands	-	-	-	-	-	26 – Herpetofauna 84 – Birds 37 – Mammals
	Eastside Grasslands	-	-	-	-	-	20 – Herpetofauna 79 – Birds 44 - Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	-	-	0.1	0.1	0.6	38 – Herpetofauna 154 – Birds 76 – Mammals
	Herbaceous Wetlands	-	-	-	1.8	12.4	18 – Herpetofauna 136 – Birds 43 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**1.9**	**13.0**	
Agriculture	Agriculture, Pastures, and Mixed Environs	-	-	-	0.4	2.6	32 – Herpetofauna 173 – Birds 77 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.4**	**2.6**	
Developed/ Altered	Urban and Mixed Environs	-	-	-	0.8	5.3	37 – Herpetofauna 131 – Birds 63 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.8**	**5.3**	

TABLE 3.6.1-1a

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats – Proposed Route (Comparison)

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/ (miles)	Mid-Seral Forest Crossed b/ (miles)	Clearcut/ Regenerating Forest Crossed c/ (miles)	Total Miles	Percent of Total Project Mileage per Vegetation Type	Number of Species Associated
Barren	Coastal Dunes and Beaches	-	-	-	-	-	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
Open Water	Open Water - Lakes, Rivers, and Streams	-	-	-	0.2	1.0	17 – Herpetofauna 94 – Birds 20 – Mammals
	Bays and Estuaries	-	-	-	-	-	1 – Herpetofauna 132 – Birds 12 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.2**	**1.0**	
	Project Total	**0.0**	**0.0**	**0.0**	**14.4**	**0.0**	

Note: Mileages rounded to nearest tenth of a mile; values less than 0.1 miles shown as "<0.1". Rows/columns may not sum correctly due to rounding.
a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).

TABLE 3.6.1-1b

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats – Blue Ridge Alternative

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/ (miles)	Mid-Seral Forest Crossed b/ (miles)	Clearcut/ Regenerating Forest Crossed c/ (miles)	Total Miles	Percent of Total Project Mileage per Vegetation Type	Number of Species Associated
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	2.9	3.0	5.5	11.5	81.7	32 – Herpetofauna 113 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	-	-	-	-	-	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	-	-	-	-	-	35 – Herpetofauna 125 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	-	-	-	-	-	31 – Herpetofauna 124 – Birds 56 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	-	-	-	-	-	32 - Herpetofauna 113 – Birds 62 – Mammals
	Western Juniper and Mountain Mahogany Woodlands	-	-	-	-	-	19 - Herpetofauna 86 – Birds 34 – Mammals
	Subtotal	**2.9**	**3.0**	**5.5**	**11.5**	**81.7**	

TABLE 3.6.1-1b

Wildlife Habitat Types Crossed by the Pacific Connector Pipeline and Wildlife Species Associated with Habitats – Blue Ridge Alternative

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/ (miles)	Mid-Seral Forest Crossed b/ (miles)	Clearcut/ Regenerating Forest Crossed c/ (miles)	Total Miles	Percent of Total Project Mileage per Vegetation Type	Number of Species Associated
Grasslands Shrubland	Shrub-steppe	-	-	-	-	-	22 – Herpetofauna 75 – Birds 46 – Mammals
	Westside Grasslands	-	-	-	-	-	26 – Herpetofauna 84 – Birds 37 – Mammals
	Eastside Grasslands	-	-	-	-	-	20 – Herpetofauna 79 – Birds 44 - Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	-	-	-	-	-	38 – Herpetofauna 154 – Birds 76 – Mammals
	Herbaceous Wetlands	-	-	-	0.8	5.9	18 – Herpetofauna 136 – Birds 43 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.8**	**5.9**	
Agriculture	Agriculture, Pastures, and Mixed Environs	-	-	-	0.7	4.8	32 – Herpetofauna 173 – Birds 77 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.7**	**4.8**	
Developed/ Altered	Urban and Mixed Environs	-	-	-	1.0	7.4	37 – Herpetofauna 131 – Birds 63 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**1.0**	**7.4**	
Barren	Coastal Dunes and Beaches	-	-	-	-	-	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
Open Water	Open Water - Lakes, Rivers, and Streams	-	-	-	0.0	0.1	17 – Herpetofauna 94 – Birds 20 – Mammals
	Bays and Estuaries	-	-	-	-	-	1 – Herpetofauna 132 – Birds 12 – Mammals
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	
	Project Total	**0.0**	**0.0**	**0.0**	**14.0**	**0.0**	

Note: Mileages rounded to nearest tenth of a mile; values less than 0.1 miles shown as “<0.1”. Rows/columns may not sum correctly due to rounding.
a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).

TABLE 3.6.1-2a

Summary of Construction-Related Disturbance (acres a/) to Corresponding Habitat Type – Proposed Route (Comparison)

General Habitat Type	Mapped Habitat Type	Forest Stand by Age	Pipeline Facilities: Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities - Klamath Compressor Station	Subtotals: Subtotal by Age Class	Subtotal by Habitat Type	Percent of Total Habitat
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O a/	5	-	1	-	-	-	-	-	7	174	76.1
		M-S b/	43	-	8	1	-	-	-	-	51		
		C-R c/	84	-	33	<1	-	-	-	<1	116		
	Montane Mixed Conifer Forest	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Ponderosa Pine Forest and Woodlands	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Western Juniper and Mountain Mahogany Woodlands	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Subtotal Forest-Woodland		131	-	42	1	-	-	-	*<1*	*174*	*174*	76.1
	Percent of All Forest-Woodland		*75.5*	-	*23.9*	*0.6*	-	-	-	-	*100.0*	-	-
Grasslands-Shrubland	Sagebrush Steppe	n/a	-	-	-	-	-	-	-	-	-	-	-
	Shrublands	n/a	-	-	-	-	-	-	-	-	-	-	-
	Westside Grasslands	n/a	-	-	<1	-	-	-	-	-	-	<1	0.1
	Eastside Grasslands	n/a	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Grasslands-Shrubland		-	-	-	-	-	-	-	-	-	**<1**	**0.1**

TABLE 3.6.1-2a

Summary of Construction-Related Disturbance (acres a/) to Corresponding Habitat Type – Proposed Route (Comparison)

General Habitat Type	Mapped Habitat Type	Forest Stand by Age	Pipeline Facilities: Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities - Klamath Compressor Station	Subtotal by Age Class	Subtotals: Subtotal by Habitat Type	Percent of Total Habitat
Wetland / Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	-	-	-	-	-	-	-	-	-	-	<1	0.4
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	<1	-	-	-	-	-	-	-	<1		
		Shrub	-	-	-	-	-	-	-	-	-	-	-
	Herbaceous Wetlands	n/a	20	-	12	-	-	-	-	-	-	33	14.3
	Subtotal Wetland / Riparian		**21**	-	**12**	-	-	-	-	-	-	**34**	**14.7**
Agriculture	Agriculture, Pastures, and Mixed Environs		5	-	6	<1	-	-	-	-	-	10	4.5
	Subtotal Agriculture		**5**	-	**6**	**<1**	-	-	-	-	-	**10**	**4.5**
Developed / Barren	Urban and Mixed Environs	n/a	<1	-	<1	-	-	-	-	-	-	1	0.5
	Roads	n/a	5	-	2	<1	-	-	-	-	-	8	3.3
	Beaches	n/a		-	-	-	-	-	-	-	-	-	-
	Subtotal Developed / Barren		**6**	-	**2**	**<1**	-	-	-	-	-	**9**	**3.8**
Open Water	Open Water - Lakes, Rivers, Streams	n/a	2	-	<1	-	-	-	-	-	-	2	0.8
	Bays and Estuaries	n/a	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Open Water		**2**	-	**<1**	-	-	-	-	-	-	**2**	0.8
	Subtotal Non-Forest		**34**	-	**20**	**<1**	-	-	-	-	-	**54**	**23.9**
	Percent of All Non-Forest		***62.4***	-	***37.5***	***0.0***	-	-	-	-	-	-	-
Project Total		n/a	**165**	-	**62**	**1**	-	-	-	**<1**	-	**229**	**100.0**
Percent of Pipeline Facilities		n/a	***72.4***	-	***27.2***	***0.5***	-	-	-		-	-	-

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

c/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

Note: Aboveground facilities not included in overall total (occur within construction right-of-way impacts)

TABLE 3.6.1-2b

Summary of Construction-Related Disturbance (acres a/) to Corresponding Habitat Type – Blue Ridge Alternative

General Habitat Type	Mapped Habitat Type	Forest Stand by Age	Pipeline Facilities: Construction Right-of-Way	Hydrostatic Discharge Sites	Temporary Extra Work Areas	Uncleared Storage Areas	Rock Source/ Disposal	Access Roads (TARs/PARs/ Improvements)	Pipe Yards	Aboveground Facilities - Klamath Compressor Station	Subtotals: Subtotal by Age Class	Subtotal by Habitat Type	Percent of Total Habitat
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O a/	34	-	7	11	-	-	-	-	51	203	83.6
		M-S b/	35	-	7	10	-	-	-	-	52		
		C-R c/	63	-	14	23	-	-	-	-	100		
	Montane Mixed Conifer Forest	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Ponderosa Pine Forest and Woodlands	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Western Juniper and Mountain Mahogany Woodlands	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
	Subtotal Forest-Woodland		132	**-**	28	44	**-**	**-**	**-**	**-**	203	*203*	83.6
	Percent of All Forest-Woodland		*64.7*	-	*13.7*	*21.6*	-	-	-	-	*100.0*	-	-
Grasslands-Shrubland	Sagebrush Steppe	n/a	-	-	-	-	-	-	-	-	-	-	-
	Shrublands	n/a	-	-	-	-	-	-	-	-	-	-	-
	Westside Grasslands	n/a	-	-	-	-	-	-	-	-	-	-	-
	Eastside Grasslands	n/a	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Grasslands-Shrubland		-	-	-	-	-	-	-	-	-	-	-

TABLE 3.6.1-2b

Summary of Construction-Related Disturbance (acres a/) to Corresponding Habitat Type – Blue Ridge Alternative

			Pipeline Facilities								Subtotals		
General Habitat Type	**Mapped Habitat Type**	**Forest Stand by Age**	**Construction Right-of-Way**	**Hydrostatic Discharge Sites**	**Temporary Extra Work Areas**	**Uncleared Storage Areas**	**Rock Source/ Disposal**	**Access Roads (TARs/PARs/ Improvements)**	**Pipe Yards**	**Aboveground Facilities - Klamath Compressor Station**	**Subtotal by Age Class**	**Subtotal by Habitat Type**	**Percent of Total Habitat**
Wetland / Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O a/	-	-	-	-	-	-	-	-	-	-	-
		M-S b/	-	-	-	-	-	-	-	-	-		
		C-R c/	-	-	-	-	-	-	-	-	-		
		Shrub	-	-	-	-	-	-	-	-	-	-	-
	Herbaceous Wetlands	n/a	10	-	3	-	-	-	-	<1	-	13	5.3
	Subtotal Wetland / Riparian		10	-	3	-	-	-	-	<1	-	13	5.3
Agriculture	Agriculture, Pastures, and Mixed Environs		8	-	3	<1	-	-	-	-	-	11	4.5
	Subtotal Agriculture		8	-	3	<1	-	-	-	-	-	11	4.5
Developed / Barren	Urban and Mixed Environs	n/a	-	-	<1	-	-	-	-	-	-	<1	0.0
	Roads	n/a	12	-	3	1	-	-	-	-	-	17	6.8
	Beaches	n/a	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Developed / Barren		12	-	3	1	-	-	-	-	-	17	6.8
Open Water	Open Water - Lakes, Rivers, Streams	n/a	<1	-	<1	-	-	-	-	-	-	<1	0.1
	Bays and Estuaries	n/a	-	-	-	-	-	-	-	-	-	-	-
	Subtotal Open Water		<1	-	<1	-	-	-	-	-	-	<1	0.1
	Subtotal Non-Forest		30	-	9	1	-	-	-	-	-	41	16.6
	Percent of All Non-Forest		*73.8*	-	*22.8*	*3.4*	-	-	-	-	-	*100.0*	*41.1*
Project Total		n/a	161	-	37	45	-	-	-	<1	-	244	100.0
Percent of Pipeline Facilities		n/a	*66.2*	-	*15.2*	*18.6*	-	-	-	-	-	-	-

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as "<1").

a/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

b/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

c/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

Note: Aboveground facilities not included in overall total (occur within construction right-of-way impacts)

TABLE 3.6.1-3a

Summary of Operation-Related Disturbance to Habitat (acres a/) – Proposed Route (Comparison)

General Vegetation Type	Mapped Vegetation Type	Forest Stand by Age	Pipeline Facilities: *30-foot Maintenance Corridor*	Pipeline Facilities: Permanent Access Roads	Pipeline Facilities: Subtotal Late Successional Old-Growth Forest	Pipeline Facilities: Subtotal Mid-Seral Forest	Pipeline Facilities: Subtotal Clearcut / Regenerating Forest	Pipeline Facilities: Subtotal By Habitat Type e/	Permanent Easement (50-foot) f/	Aboveground Facilities	Total Operation Impacts by Habitat Type
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O b/	2	-					3		
		M-S c/	13	-	-	-	-	41	22	<1	**41**
		C-R d/	26	-					44		
	Montane Mixed Conifer Forest	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Ponderosa Pine Forest and Woodlands	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Western Juniper and Mountain Mahogany Woodlands	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Subtotal Forest-Woodland		**41**	**0**	**0**	**0**	**0**	**41**	***69***	**<1**	**41**
Grasslands-Shrubland	Sagebrush Steppe		-	-	-	-	-	-	-	-	-
	Shrublands		-	-	-	-	-	-	-	-	-
	Westside Grasslands		-	-	-	-	-	-	-	-	-
	Eastside Grasslands		-	-	-	-	-	-	-	-	-
	Subtotal Grasslands-Shrubland		**0**	**0**	**0**	**0**	**0**	**0**	***0***	**0**	**0**
Wetland/Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	<1	-	-	<1
		C-R d/	<1	-					*<1*		
		Shrub	-	-	-	-	-	-	-	-	
	Herbaceous Wetlands		6	-	-	-	-	6	-	-	6
	Subtotal Wetland/Riparian		**7**	**0**	**0**	**0**	**0**	**7**	***<1***	**0**	**7**
Agriculture	Agriculture, Pastures, and Mixed Environs	n/a	1	-	-	-	-	1	*2*	-	1
	Subtotal Agriculture		**1**	**0**	**0**	**0**	**0**	**1**	***2***	**0**	**1**

TABLE 3.6.1-3a

Summary of Operation-Related Disturbance to Habitat (acres a/) – Proposed Route (Comparison)

General Vegetation Type	**Mapped Vegetation Type**	**Forest Stand by Age**	**Pipeline Facilities: *30-foot Maintenance Corridor***	**Pipeline Facilities: Permanent Access Roads**	**Pipeline Facilities: Subtotal Late Successional Old-Growth Forest**	**Pipeline Facilities: Subtotal Mid-Seral Forest**	**Pipeline Facilities: Subtotal Clearcut / Regenerating Forest**	**Pipeline Facilities: Subtotal By Habitat Type e/**	**Permanent Easement (50-foot) f/**	**Aboveground Facilities**	**Total Operation Impacts by Habitat Type**
Developed / Barren	Urban and Mixed Environs	n/a	<1	-	-	-	-	<1	*<1*	-	<1
	Roads	n/a	-	-	-	-	-			-	
	Beaches	n/a	2	-	-	-	-	2	*4*	-	2
	Subtotal Developed / Barren		**3**	**0**	**0**	**0**	**0**	**3**	***4***	**0**	**3**
Open Water	Open Water - Lakes, Rivers, and Streams	n/a	<1	-	-	-	-	<1	*<1*	-	<1
	Bays and Estuaries	n/a	-	-	-	-	-	-	-	-	-
	Subtotal Open Water		**<1**	**0**	**0**	**0**	**0**	**<1**	***<1***	**0**	**<1**
	Subtotal Non-Forest		**11**	**0**	**0**	**0**	**0**	**11**	***19***	**0**	**11**
	Project Total		**52**	**0**	**0**	**0**	**0**	**52**	***87***	**<1**	**52**

General: Columns and rows do not necessarily sum correctly due to rounding. Acres rounded to nearest whole acre. Values less than 1 acre shown as "<1".

Acres of impacts to non-vegetated areas are included within this table for consistency in values reported within this document.

a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.

b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

d/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

e/ Subtotal by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves located within the 30-foot maintenance corridor).

f/ On BLM-managed lands, there would not be a "permanent easement", only an "operational easement."

TABLE 3.6.1-3b

Summary of Operation-Related Disturbance to Habitat (acres a/) – Blue Ridge Alternative

			Pipeline Facilities								
General Vegetation Type	**Mapped Vegetation Type**	**Forest Stand by Age**	***30-foot Maintenance Corridor***	**Permanent Access Roads**	**Subtotal Late Successional Old-Growth Forest**	**Subtotal Mid-Seral Forest**	**Subtotal Clearcut / Regenerating Forest**	**Subtotal By Habitat Type e/**	**Permanent Easement (50-foot) f/**	**Aboveground Facilities**	**Total Operation Impacts by Habitat Type**
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	L-O b/	11	-					18		
		M-S c/	11	-	11	11	20	42	18	-	**42**
		C-R d/	20	-					34		
	Montane Mixed Conifer Forest	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Southwest Oregon Mixed Conifer-Hardwood Forest	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Ponderosa Pine Forest and Woodlands	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Westside Oak and Dry Douglas-fir Forest and Woodlands	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Western Juniper and Mountain Mahogany Woodlands	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
	Subtotal Forest-Woodland		**42**	**0**	**0**	**0**	**0**	**0**	***69***	**0**	**42**
Grasslands-Shrubland	Sagebrush Steppe		-	-	-	-	-	-	-	-	-
	Shrublands		-	-	-	-	-	-	-	-	-
	Westside Grasslands		-	-	-	-	-	-	-	-	-
	Eastside Grasslands		-	-	-	-	-	-	-	-	-
	Subtotal Grasslands-Shrubland		**0**	**0**	**0**	**0**	**0**	**0**	***0***	**0**	**0**
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	L-O b/	-	-					-		
		M-S c/	-	-	-	-	-	-	-	-	-
		C-R d/	-	-					-		
		Shrub	-	-	-	-	-	-	-	-	-
	Herbaceous Wetlands		3	-	-	-	-	3	*5*	<1	3
	Subtotal Wetland/Riparian		**3**	**0**	**0**	**0**	**0**	**3**	***5***	**<1**	**3**
Agriculture	Agriculture, Pastures, and Mixed Environs	n/a	3	-	-	-	-	3	*4*	-	3
	Subtotal Agriculture		**3**	**0**	**0**	**0**	**0**	**3**	***4***	**0**	**3**

TABLE 3.6.1-3b

Summary of Operation-Related Disturbance to Habitat (acres a/) – Blue Ridge Alternative

			Pipeline Facilities								
General Vegetation Type	**Mapped Vegetation Type**	**Forest Stand by Age**	***30-foot Maintenance Corridor***	**Permanent Access Roads**	**Subtotal Late Successional Old-Growth Forest**	**Subtotal Mid-Seral Forest**	**Subtotal Clearcut / Regenerating Forest**	**Subtotal By Habitat Type e/**	**Permanent Easement (50-foot) f/**	**Aboveground Facilities**	**Total Operation Impacts by Habitat Type**
Developed / Barren	Urban and Mixed Environs	n/a	-	-	-	-	-	-	-	-	-
	Roads	n/a	4	-	-	-	-	4	*6*	-	4
	Beaches	n/a	-	-	-	-	-	-	-	-	
	Subtotal Developed / Barren		**4**	**0**	**0**	**0**	**0**	**4**	***6***	**0**	**4**
Open Water	Open Water - Lakes, Rivers, and Streams	n/a	<1	-	-	-	-	<1	*<1*	-	<1
	Bays and Estuaries	n/a	-	-	-	-	-	-	-	-	-
	Subtotal Open Water		**<1**	**0**	**0**	**0**	**0**	**<1**	***<1***	**0**	**<1**
	Subtotal Non-Forest		**9**	**0**	**0**	**0**	**0**	**9**	***16***	**0**	**9**
	Project Total		**51**	**0**	**0**	**0**	**0**	**51**	***85***	**0**	**51**

Notes refer to complete project (232 miles).

General: Columns and rows do not necessarily sum correctly due to rounding. Acres rounded to nearest whole acre. Values less than 1 acre shown as "<1".

Acres of impacts to non-vegetated areas are included within this table for consistency in values reported within this document.

a/ Acres disturbed were evaluated using GIS; footprints for each component (aboveground facilities, permanent easement, and 30-foot maintenance corridor) were overlaid on the digitized vegetation coverage.

b/ The "Late Successional and Old-Growth" category (L-O) describes those forest areas with a majority of trees over 80 years of age. Forests with stands greater than 175 years are considered to have old-growth characteristics.

c/ The "Mid-Seral" category (M-S) describes those forest areas with a majority of trees over 40 years of age but less than 80 years of age.

d/ The "Grass-shrub-sapling or Regenerating Young Forest" category (C-R) describes those forest areas that are either clear-cut (tree age 0-5 years) or regenerating (tree age 5 to 40 years). Forest areas in this category are divided into forest vegetation types based on their potential to become those types of forests.

e/ Subtotal by Habitat Type includes the 30-foot maintenance corridor, permanent access roads, and only aboveground facilities with a meter station or compressor station (mainline block valves located within the 30-foot maintenance corridor).

f/ On BLM-managed lands, there would not be a "permanent easement", only an "operational easement."

TABLE 3.6.1-4

Summary of ODFW Habitat Categories and Impact (Acres) from the Pacific Connector Pipeline, by Alternative

Proposed Action	Project Component	ODFW Habitat Category (acres) a/ 1	2	3	4	5	6
Proposed Route (Comparison)							
Impact on Non-Federal Lands							
Construction	Removed b/	3	68	54	74	1	7
Impact	Modified c/	0	0	1	0	0	0
Operational	30' Maintenance Corridor d/	1	17	12	15	0	2
Impact	Aboveground Facilities e/	-	-	-	-	-	-
Impact on Federal Lands							
Construction	Removed b/	0	11	6	3	0	0
Impact	Modified c/	0	0	0	0	0	0
Operational	30' Maintenance Corridor d/	0	2	2	1	0	0
Impact	Aboveground Facilities e/	-	-	-	-	-	-
Total Pipeline Project Impacts (Federal and Non-Federal Lands)							
Construction	Removed b/	3	79	60	78	1	8
Impact	Modified c/	0	0	1	0	0	0
Operational	30' Maintenance Corridor d/	1	19	14	16	0	2
Impact	Aboveground Facilities e/	-	-	-	-	-	-
Blue Ridge Alternative							
Impact on Non-Federal Lands							
Construction	Removed b/	8	31	26	27	0	4
Impact	Modified c/	3	5	4	5	0	0
Operational	30' Maintenance Corridor d/	2	7	6	7	0	1
Impact	Aboveground Facilities e/	-	-	-	-	-	-
Impact on Federal Lands							
Construction	Removed b/	39	18	28	7	0	11
Impact	Modified c/	11	5	8	3	0	1
Operational	30' Maintenance Corridor d/	10	5	7	2	0	3
Impact	Aboveground Facilities e/	-	-	-	-	-	-
Total Pipeline Project Impacts (Federal and Non-Federal Lands)							
Construction	Removed b/	47	49	53	34	0	15
Impact	Modified c/	14	10	12	8	0	1
Operational	30' Maintenance Corridor d/	12	12	14	9	0	4
Impact	Aboveground Facilities e/	-	-	-	-	-	-

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Category 1 – irreplaceable, essential habitat that is limited
Category 2 – essential habitat that is limited
Category 3 – essential habitat, or important habitat that is limited
Category 4 – important habitat
Category 5 – habitat having a high potential to become essential or important habitat
Category 6 – habitat that has a low potential to become essential or important habitat

b/ Construction components considered for habitat removal include construction right-of-way, TEWAs, aboveground facilities, pipe storage yards, hydrostatic test sites, rock source and disposal sites, and temporary and permanent access roads.

c/ Modified acres include habitat potentially affected within identified UCSAs.

d/ Within the 30-foot maintenance corridor, habitat would be maintained in an herbaceous and/or shrub state, cutting or removing vegetation greater than 6 inches in height; however, in areas with pre-construction habitat types of agricultural land, bare ground such as beaches, waterbodies, wetlands, and estuarine habitat types, the maintenance corridor would be restored to its pre-construction habitat type or land use. This acreage does not include aboveground facilities.

e/ Aboveground facilities, including meter stations and communication towers, block valves, and a compressor station, would be maintained in a non-herbaceous, industrial state (graveled and/or concrete) for the life of the project.

3.6.1.1 Wildlife Resources on BLM Lands

On BLM lands, construction of the comparison portion of the proposed route would impact approximately 19 acres of forest-woodland habitat, none of which would be LSOG, and no wetland/riparian habitat (table 3.6.1.1-1a). Construction of the Blue Ridge Alternative would impact approximately 118 acres of forest-woodland habitat, including 46 acres of LSOG, and no wetland/riparian habitat (table 3.6.1.1-1b). Additional discussion of special status species on BLM-managed lands is included below in Section 3.7.

TABLE 3.6.1.1-1a

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on BLM Land, and Wildlife Species Associated with Johnson and O'Neal (2001) Habitats – Proposed Route (Comparison)

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/ (acres)	Mid-Seral Forest Crossed b/ (acres)	Clearcut/ Regenerating Forest Crossed c/ (acres)	Total Acres	Number of Species Associated
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	-	15	4	19	32 – Herpetofauna 113 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	-	-	-	-	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	-	-	-	-	35 – Herpetofauna 125 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	-	-	-	-	31 – Herpetofauna 124 – Birds 56 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	-	-	-	-	32 - Herpetofauna 113 – Birds 62 – Mammals
	Western Juniper and Mountain Mahogany Woodlands	-	-	-	-	19 - Herpetofauna 86 – Birds 34 – Mammals
	Subtotal	**0**	**15**	**4**	**19**	
Grasslands Shrubland	Shrub-steppe	-	-	-	-	22 – Herpetofauna 75 – Birds 46 – Mammals
	Westside Grasslands	-	-	-	-	26 – Herpetofauna 84 – Birds 37 – Mammals
	Eastside Grasslands	-	-	-	-	20 – Herpetofauna 79 – Birds 44 - Mammals
	Subtotal	**0**	**0**	**0**	**0**	–
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	-	-	-	-	38 – Herpetofauna 154 – Birds 76 – Mammals
	Herbaceous Wetlands	-	-	-	-	18 – Herpetofauna 136 – Birds 43 – Mammals
	Subtotal	**0**	**0**	**0**	**0**	
Agriculture	Agriculture, Pastures, and Mixed Environs	-	-	-	-	32 – Herpetofauna 173 – Birds 77 – Mammals
	Subtotal	**0**	**0**	**0**	**0**	

TABLE 3.6.1.1-1a

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on BLM Land, and Wildlife Species Associated with Johnson and O'Neal (2001) Habitats – Proposed Route (Comparison)

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/ (acres)	Mid-Seral Forest Crossed b/ (acres)	Clearcut/ Regenerating Forest Crossed c/ (acres)	Total Acres	Number of Species Associated
Developed/ Altered	Urban and Mixed Environs	-	-	-	<1	37 – Herpetofauna 131 – Birds 63 – Mammals
	Roads	-	-	-	<1	N/A
	Subtotal	**0**	**0**	**0**	**<1**	
Barren	Coastal Dunes and Beaches	-	-	-	-	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	**0**	**0**	**0**	**0**	
Open Water	Open Water - Lakes, Rivers, and Streams	-	-	-	<1	17 – Herpetofauna 94 – Birds 20 – Mammals
	Subtotal	**0**	**0**	**0**	**0**	
	Project Total	**0**	**15**	**4**	**20**	

Note: Rows and columns may not sum correctly due to rounding. Acreages rounded to nearest whole acre; values less than 1 acre shown as "<1".
a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).
b/ Mid-Seral Forest (40 to 80 years).
c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).

TABLE 3.6.1.1-1b

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on BLM Land, and Wildlife Species Associated with Johnson and O'Neal (2001) Habitats – Blue Ridge Alternative

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/ (acres)	Mid-Seral Forest Crossed b/ (acres)	Clearcut/ Regenerating Forest Crossed c/ (acres)	Total Acres	Number of Species Associated
Forest-Woodland	Westside Lowland Conifer-Hardwood Forest	46	27	45	118	32 – Herpetofauna 113 – Birds 66 – Mammals
	Montane Mixed Conifer Forest	-	-	-	-	21 – Herpetofauna 94 – Birds 60 – Mammals
	Southwest Oregon Mixed Conifer-Hardwood Forest	-	-	-	-	35 – Herpetofauna 125 – Birds 64 – Mammals
	Ponderosa Pine Forest and Woodlands	-	-	-	-	31 – Herpetofauna 124 – Birds 56 – Mammals
	Westside Oak and Dry Douglas-fir Forest and Woodlands	-	-	-	-	32 - Herpetofauna 113 – Birds 62 – Mammals

TABLE 3.6.1.1-1b

Acres of Construction-Related Disturbance to Wildlife Habitat Types by the Pacific Connector Pipeline on BLM Land, and Wildlife Species Associated with Johnson and O'Neal (2001) Habitats – Blue Ridge Alternative

General Vegetation Type	Mapped Vegetation Type	Late Successional or Old-Growth Forest Crossed a/ (acres)	Mid-Seral Forest Crossed b/ (acres)	Clearcut/ Regenerating Forest Crossed c/ (acres)	Total Acres	Number of Species Associated
	Western Juniper and Mountain Mahogany Woodlands	-	-	-	-	19 - Herpetofauna 86 – Birds 34 – Mammals
	Subtotal	46	27	45	**118**	
Grasslands Shrubland	Shrub-steppe	-	-	-	-	22 – Herpetofauna 75 – Birds 46 – Mammals
	Westside Grasslands	-	-	-	-	26 – Herpetofauna 84 – Birds 37 – Mammals
	Eastside Grasslands	-	-	-	-	20 – Herpetofauna 79 – Birds 44 - Mammals
	Subtotal	**0**	**0**	**0**	**0**	–
Wetland/ Riparian	Westside Riparian-Wetlands/Eastside Riparian-Wetlands	-	-	-	-	38 – Herpetofauna 154 – Birds 76 – Mammals
	Herbaceous Wetlands	-	-	-	-	18 – Herpetofauna 136 – Birds 43 – Mammals
	Subtotal	**0**	**0**	**0**	**0**	
Agriculture	Agriculture, Pastures, and Mixed Environs	-	-	-	-	32 – Herpetofauna 173 – Birds 77 – Mammals
	Subtotal	**0**	**0**	**0**	**0**	
Developed/ Altered	Urban and Mixed Environs	-	-	-	<1	37 – Herpetofauna 131 – Birds 63 – Mammals
	Roads	-	-	-	12	N/A
	Subtotal	**0**	**0**	**0**	**12**	
Barren	Coastal Dunes and Beaches	-	-	-	-	6 – Herpetofauna 100 – Birds 26 – Mammals
	Subtotal	**0**	**0**	**0**	**0**	
Open Water	Open Water - Lakes, Rivers, and Streams	-	-	-	<1	17 – Herpetofauna 94 – Birds 20 – Mammals
	Subtotal	**0**	**0**	**0**	**<1**	
	Project Total	**46**	**27**	**45**	**130**	

Note: Rows and columns may not sum correctly due to rounding. Acreages rounded to nearest whole acre; values less than 1 acre shown as "<1".

a/ Late Successional (80 to 175 years) and Old-Growth Forest (175 + years).

b/ Mid-Seral Forest (40 to 80 years).

c/ Clearcut (0 to 5 years) and Regenerating Forest (5 to 40 years).

3.6.2 Aquatic Resources

Tables 3.6.2-1a and 3.6.2-1b summarize the effects to aquatic resources from construction of the comparison portion of the proposed route and Blue Ridge Alternative.

TABLE 3.6.2-1a

Approximate Associated Construction Disturbance and Aboveground Facilities and Their Potential Effects to Aquatic Resources – Proposed Route (Comparison)

Category	Facility	Location	Notes	Effects to Aquatic Resources
Pipeline-related facilities	Hydrostatic testing	3 potential sites, 1 site located outside of construction right- of-way.	A *Hydrostatic Testing Plan* addressing protection procedures has been developed.	Potential erosion to streams and invasive species introduction if not properly managed. Potential flow reduction during withdrawal. Measures from ECRP and *Hydrostatic Testing Plan* (part of the POD) would avoid adverse effects.
	Construction Right-of-Way and Temporary extra work areas (TEWAs)	Construction right-of-way and 140 TEWAs would impact 33.6 acres of wetlands and 1.8 acres of waterbodies and ditches	9 are known anadromous fish bearing	Potential for erosion or hazardous spills. Slight LWD and shade reduction Measures from ECRP and SPCC and other measures in the POD would avoid adverse effects.
	Uncleared storage areas (UCSAs)	No UCSAs within riparian zones	No waterbodies directly affected	
	Rock sources, and permanent disposal sites	5 rock source/disposal sites – also identified as TEWAs	None are within 50 feet of a wetland or waterbody	Potential sediment runoff to stream. Measures from the ECRP, SPCCP, and other POD items would avoid adverse effects.
Construction access roads	New Temporary Access Roads (TARs) segments to be constructed, near streams	None proposed	-	-
	1 new Permanent Access Road (PAR)	No wetlands, waterbodies, or riparian areas affected	-	ECRP, SPCCP, and other POD items would avoid potential adverse effects.
	Improved Existing Access Roads	None proposed	-	
Above-ground facilities	BV#2	No wetlands or waterbodies affected.	-	No effect due to distance and use of measures from the ECRP, SPCCP, and other POD items.

TABLE 3.6.2-1b

Approximate Associated Construction Disturbance and Aboveground Facilities and Their Potential Effects to Aquatic Resources – Blue Ridge Alternative

Category	Facility	Location	Notes	Effects to Aquatic Resources
Pipeline-related facilities	Hydrostatic testing	Not currently designed, but expected to be similar to the proposed route segment (3 potential sites with 1 possible site outside of construction right-of-way). .	A *Hydrostatic Testing Plan* addressing protection procedures has been developed.	Potential erosion to streams and invasive species introduction if not properly managed. Potential flow reduction during withdrawal. Measures from ECRP and *Hydrostatic Testing Plan* (part of the POD) would avoid adverse effects.
	Construction Right-of-Way and Temporary extra work areas (TEWAs)	Construction right-of-way and 95 TEWAs would impact 12 acres of wetland and 0.2 acre of waterbodies	4 are known fish bearing	Potential for erosion or hazardous spills. Slight LWD and shade reduction Measures from ECRP and SPCC and other measures in the POD would avoid adverse effects.
	Uncleared storage areas (UCSAs)	42 UCSAs with 0.4 acre in riparian zones of 2 known fish bearing streams	No waterbodies directly affected	Some potential for sedimentation effects to aquatic resources. Slight LWD and shade reduction. Measures from ECRP would avoid or reduce adverse effects.
	Rock sources, and permanent disposal sites	None proposed	-	-
Construction access roads	New Temporary Access Roads (TARs) segments to be constructed, near streams	None proposed	-	-
	New Permanent Access Road (PAR)	None proposed	-	-
	Improved Existing Access Roads	None proposed	-	-
Above-ground facilities	BV-2	< 0.1 acre of permanent wetland fill	Block valve located in an emergent pasture wetland (NWI - interpreted)	Compensatory mitigation would occur within Pacific Connector Proposed Kentuck Slough Mitigation Site Potential sedimentation effects. Measures from the ECRP, SPCCP, and other POD items would minimize adverse effects.

Overall, the comparison portion of the proposed route would cross 41 perennial streams and 23 intermittent streams, while the Blue Ridge Alternative would cross 4 perennial and 4 intermittent streams (table 3.6.2-2). Of the streams crossed by the comparison portion of the proposed route, 14 are known or assumed to support anadromous species (including essential fish habitat [EFH] and Endangered Species Act [ESA] species) and 12 are known or assumed to support resident fish species. Of the streams crossed by the Blue Ridge Alternative, 4 are known or assumed to support anadromous fish species (including EFH and ESA species) and 5 are assumed to support resident species (table 3.6.2-2). Though the Blue Ridge Alternative crosses the boundary line of the South Fork Coos River watershed, no streams are crossed within that watershed.

TABLE 3.6.2-2

Number of Streams, Ponds, Estuary Channels Crossed by the Pacific Connector Pipeline by Fish Status Category and Fifth-Field Watershed, by Alternative

Fifth-Field Watershed	Perennial Streams	Intermittent Streams	Fish-bearing Streams with: Anadromous Species (assumed) a/	Fish-bearing Streams with: Resident Species (assumed) a/, b/	EFH Species and Habitat Present (assumed) a/	ESA Species or Habitat Present (assumed) a/
Proposed Route (Comparison)						
Coos Bay Frontal	35	15	8(3)	4(5)	8(3)	8(3)
Coquille River	5	1	1(1)	1	0(2)	0(2)
North Fork Coquille River	1	7	0(1)	1	0(1)	0(1)
TOTAL	**41**	**23**	**9(5)**	**6(6)**	**8(6)**	**8(6)**
Blue Ridge Alternative						
Coos Bay Frontal	2	4	3	0(3)	3	3
South Fork Coos River	-	-	-	-	-	-
North Fork Coquille River	2	-	1	0(2)	1	1
TOTAL	**4**	**4**	**4**	**0(5)**	**4**	**4**

a/ Known and assumed, possible or likely (value in parentheses) crossings or pipeline proximity with indicated fish category designation.
b/ Includes primarily cold water trout, but also estuarine species in lower Coos system.

Table 3.6.2-3 indicates the proposed waterbody crossing methods for both the comparison portion of the proposed route and Blue Ridge Alternative. Neither route would require a horizontal directional drill (HDD) crossing. The comparison portion of the proposed route includes one bore operation, and 61 dry open-cut crossings. The Blue Ridge Alternative includes eight dry open-cut crossings.

TABLE 3.6.2-3

Proposed Waterbody Crossing Methods for Waterbody Crossings by Fifth-Field Watersheds, by Alternative

Fifth-Field Watershed	Number of Waterbodies Crossed, by Construction Method: HDD or Direct Pipe	Bore	Wet Open-Cut	Diverted Open-Cut	Dry Open-Cut	Total Crossed	Adjacent Not Crossed a/	Bedrock b/
Proposed Route (Comparison)								
Coos Bay Frontal	-	1	-	-	47	48	5	1
Coquille River	-	-	-	-	6	6	-	2
North Fork Coquille River	-	-	-	-	8	8	-	2
TOTAL	**0**	**1**	**0**	**0**	**61**	**62**	**5**	**5**
Blue Ridge Alternative								
Coos Bay Frontal	-	-	-	-	6	6	-	-
South Fork Coos River	-	-	-	-	-	0	-	-
North Fork Coquille River	-	-	-	-	2	2	-	-
TOTAL	**0**	**0**	**0**	**0**	**8**	**8**	**0**	**0**

a/ Waterbodies within the construction right-of-way that would not be crossed.
b/ Bedrock streambeds would be crossed by dry open-cuts but may require special construction techniques to ensure pipeline design depth including rock hammering, drilling and hammering, or blasting. The need for blasting would be determined by the contractor and would only be initiated after ODFW blasting permits are obtained. Numbers are not in addition to Total Crossed as they are already included in the Dry-Open Cut counts shown.

Table 3.6.2-4 summarizes the acres of impact to riparian areas within one site-potential tree height of perennial and intermittent waterbodies crossed or near the comparison portion of the proposed route and Blue Ridge Alternative. Overall, the comparison portion of the proposed route would affect 103 acres of riparian area, while the Blue Ridge Alternative would affect 50 acres.

TABLE 3.6.2-4

Total Riparian Area (acres within one site-potential tree height distance) Disturbed (a/) by Construction Activities Adjacent to Perennial and Intermittent Waterbodies Crossed/Near by the Pacific Connector Pipeline, by Alternative

Landowner	Forest Habitat b/					Other Habitat b/						Total Riparian Area Impact (acres)
	Late Successional Old-Growth Forest	Mid-Seral Forest	Forest Regenerating	Clearcut, Forest	Forest Total	Forested Wetland c/	Wetland Nonforested c/	Nonforested Habitat Unaltered	Agriculture	Altered Habitat	Other	
Proposed Route (Comparison)												
BLM-Coos Bay District	-	8	<1	<1	9	-	-	-	-	<1	<1	**9**
Non-Federal Subtotal	<1	14	43	4	62	-	23	-	5	2	2	94
Overall Total	**<1**	**21**	**43**	**5**	**70**	**0**	**23**	**0**	**5**	**2**	**2**	**103**
Blue Ridge Alternative												
BLM-Coos Bay District	5	<1	4	-	**9**	-	-	-	-	2	<1	**11**
Non-Federal Subtotal	<1	7	8	<1	**16**	-	12	-	10	<1	<1	**39**
Overall Total	**6**	**7**	**13**	**<1**	**26**	**0**	**12**	**0**	**10**	**3**	**<1**	**50**

Note: Rows/columns may no sum correctly due to rounding. Acres rounded to nearest whole acre; acreages less than 1 are shown as <1.

a/ Project components considered in calculation of habitat "Disturbed": Pacific Connector construction right-of-way, temporary extra work areas, aboveground facilities, and permanent and temporary access roads. Note that federal lands have "riparian reserve" areas along streams that differ in size than those areas shown here.

b/ Habitat Types within Riparian Zones generally categorized as: Late Successional (Mature) or Old-Growth Forest (coniferous, deciduous, mixed ≥80 years old); Mid-Seral Forests (coniferous, deciduous, mixed ≥40 but ≤80 years old); Regenerating Forest (coniferous, deciduous, mixed ≥5 but ≤40 years old); Clearcut Forests; Wetland Forested, Unaltered Nonforested Habitat (grasslands, sagebrush, shrublands), and Altered Habitats (urban, industrial, residential, roads, utility corridors, quarries).

3.6.2.1 Stream Crossing Risk Analysis

Table 3.6.2.1-1 summarizes the results of the stream crossing risk analysis for the comparison portion of the proposed route and Blue Ridge Alternative. The Orange category is considered of greatest risk from project actions on bank and bed stability. The comparison portion of the proposed route would include 6 stream crossings ranked Orange, while the Blue Ridge Alternative would have none. Most of the crossings for both routes are either Blue or Yellow, with Blue representing the lowest risk and Yellow a moderate risk. All ranking categories and the risk assessment are further described in section 4.6.2.3 of the EIS.

TABLE 3.6.2.1-1

Summary of Site-Specific Rankings and Management Categories, by Alternative

Ranking	Proposed Route (Comparison)	Blue Ridge Alternative
Blue	20	4
Green	0	1
Yellow	21	3
Orange	6	0
Total Crossings	**47**	**8**

Notes:
Blue = Pacific Connector Project Typical Construction
Green = Pacific Connector Project Typical Construction with Habitat Enhancement BMPs
Yellow = Pacific Connector Project Typical Construction with BMPs for sensitive bed, bank, or riparian revegetation conditions to be selected by Environmental Inspector during construction
Orange = Pacific Connector Project Typical Construction with BMPs for sensitive bed, bank or riparian vegetation conditions selected by qualified professional prior to construction based on site-specific information from pre-construction evaluation

3.6.2.2 Aquatic Resources on BLM Land

The comparison portion of the proposed route would not cross any perennial streams on BLM-managed lands and 4 intermittent streams (table 3.6.2.2-1). The Blue Ridge Alternative would cross one perennial stream, no intermittent streams, and the perennial stream may support resident fish species but no EFH or ESA species (table 3.6.2.2-1).

TABLE 3.6.2.2-1

Number of Streams Crossed on BLM-Managed Lands by Fish Status Category within Each Fifth-Field Watershed Coinciding with the Pacific Connector Project, by Alternative

Fifth Field Watershed	Perennial Streams	Intermittent Streams	Fish-bearing Streams with (a/): Anadromous Species (assumed) b/	Fish-bearing Streams with (a/): Resident Species (assumed) a/,b/	EFH Species and Habitat Present (assumed) a/	ESA Species or Habitat Present (assumed) a/
Proposed Route (Comparison)						
Coos Bay Frontal	0	1	0	0	0	0
Coquille River	0	0	0	0	0	0
North Fork Coquille River	0	3	0	0	0	0
TOTAL	**0**	**4**	**0**	**0**	**0**	**0**
Blue Ridge Alternative						
Coos Bay Frontal	0	0	0	0	0	0
South Fork Coos River	0	0	0	0	0	0
North Fork Coquille River	1	0	0	(1)	0	0
TOTAL	**1**	**0**	**0**	**0(1)**	**0)**	**0**

a/ Known and assumed (value in parentheses) crossings by the pipeline with indicated fish category designation
b/ Trout
Note: Numbers based on federal agency analysis of streams, which may differ from Pacific Connector's analysis in some watersheds.

3.7 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

3.7.1 Federally Listed Threatened and Endangered Species

The federally-listed endangered, threatened, and proposed species that potentially occur in the project area are listed in table 4.7.1-1 of the FEIS and would not change when considering the Blue Ridge Alternative and comparison portion of the proposed route.

Tables 3.7.1-1 and 3.7.1-2 summarize the acres of affected MAMU and northern spotted owl (NSO) habitat by the comparison portion of the proposed route and Blue Ridge Alternative. The comparison portion of the proposed route would impact 3 acres of suitable, 45 acres of recruitment, and 127 acres of capable MAMU habitat for a total of 175 acres (table 3.7.1-1). The Blue Ridge Alternative would impact 54 acres of suitable, 31 acres of recruitment, and 117 acres of capable MAMU habitat for a total of 203 acres (table 3.7.1-1).

For both routes, the total acreage of NSO habitat affected mirrors MAMU habitat affected at 175 and 203 acres for the comparison portion of the proposed route and Blue Ridge Alternative, respectively (table 3.7.1-2). Of that total, the proposed route affects no high NRF habitat and 7 acres of NRF habitat, while the Blue Ridge Alternative affects 23 acres of high NRF and 43 acres of NRF habitat for the NSO (table 3.7.1-2).

TABLE 3.7.1-1

Summary of Affected Marbled Murrelet Habitat (acres), by Alternative

		Acres of MAMU Habitat Affected					
		Suitable					
Route	**Proposed Action a/**	**Occupied Stand**	**Presumed Occupied**	**Total**	**Recruitment**	**Capable**	**Total**
Proposed Route (Comparison)	Habitat Removed	-	3	3	44	126	174
	Habitat Modified	-	-	-	1	<1	1
	Total	**0**	**3**	**3**	**45**	**127**	**175**
Blue Ridge Alternative	Habitat Removed	25	16	41	26	91	159
	Habitat Modified	9	4	13	5	26	44
	Total	**34**	**21**	**54**	**31**	**117**	**203**

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as “<1”).
a/ Habitat Removed = right-of-way, TEWAs; Habitat Modified = UCSAs

TABLE 3.7.1-2

Summary of Affected Northern Spotted Owl Habitat (acres), by Alternative

		Acres of NSO Habitat Affected				
Route	**Proposed Action a/**	**High NRF**	**NRF**	**Dispersal Only**	**Capable**	**Total**
Proposed Route (Comparison)	Habitat Removed	-	7	50	117	174
	Habitat Modified	-	-	1	<1	1
	Total	**0**	**7**	**51**	**117**	**175**
Blue Ridge Alternative	Habitat Removed	20	33	30	77	159
	Habitat Modified	3	11	7	23	44
	Total	**23**	**43**	**37**	**100**	**203**

Note: Rows and columns may not sum correctly due to rounding. Acres are rounded to nearest whole acre (values below 1 are shown as “<1”).
a/ Habitat Removed = right-of-way, TEWAs; Habitat Modified = UCSAs

3.7.2 Other Special Status Species

3.7.2.1 BLM Sensitive Species

The Blue Ridge Alternative would cross 36 non-vascular plants on Coos Bay BLM District-managed lands, as compared to 34 for the comparison portion of the proposed route. No other BLM sensitive species would be impacted by either route.

3.7.2.2 Survey and Manage Species

Consistent with the approach documented in appendix K to the FEIS, a supplemental attachment to that appendix was prepared for the Blue Ridge Alternative. This attachment is based on information on Survey & Manage (S&M) species provided by the applicant and available to the BLM when the FEIS was published is subject to change at the point in time when all surveys are completed by the applicant at some point after the FEIS is issued by FERC.

The S&M species evaluated in the referenced attachment to appendix K are those that could be affected by the Blue Ridge Alternative. Based on this evaluation the following conclusions were made for the 12 S&M species that could be affected by the PCGP Project within the Blue Ridge Alternative. The species listed below appear to be more common than previously documented or are relatively common across the range of the NSO based on new information available from surveys for the PCGP Project and/or other sources since the species were listed in the 2001 S&M Record of Decision (ROD). For these S&M species, the PCGP Project with the Blue Ridge Alternative would affect individuals or habitat at one or more sites and could affect site persistence, but the remaining sites in the NSO range would continue to provide a reasonable assurance of species persistence:

Fungi:
Cantharellus subalbidus
Phaeocollybia dissiliens
Phaeocollybia spadicea
Ramaria stuntzii

Lichens:
Cetrelia cetrarioides
Chaenotheca chrysocephala
Platismatia lacunosa
Pseudocyphellaria perpetua
Stenocybe clavata

The species listed below are not necessarily more common than previously documented despite new information available from pre-disturbance surveys for the PCGP Project and/or other sources since the species were listed in the 2001 S&M ROD. For these species, the PCGP Project with the Blue Ridge Alternative would affect individuals or habitat at one or more sites and could affect site persistence, but the remaining sites in the NSO range would continue to provide a reasonable assurance of species persistence:

Lichens:
Bryoria subcana
Hypotrachyna revoluta
Ramalina thrausta

Table 4.7.4.3-6 in the FEIS lists the lichen species documented along the proposed route and would not change when considering the comparison portion. For the Blue Ridge Route, two lichen species documented within 100 feet of the proposed habitat removal would be added: *Platismatia lacunosa* and *Stenocybe clavata* (table 3.7.2.2-1)

TABLE 3.7.2.2-1

Special Status Lichen Species Documented During Blue Ridge Survey Efforts

Code	Species	# of Observations Located	2001	2003	Approximate MP	Distance from Habitat Removal (feet)
PLLA6	*Platismatia lacunose*	1	C	E	18.91	282' W of TEWA
STCL6	*Stenocybe clavata*	2	E	E	17.27	0' (ROW)
					17.27	24' E of ROW
PSPE6	*Pseudocyphellaria perpetua*	1	B	A	17.28	0' (TEWA)
CECE4	*Cetrelia cetrarioides*	1	E	E	17.44	170' SW of TEWA
RATH2	*Ramalina thrausta*	1	A	OFF	23.36	401' NE of ROW

3.8 RECREATION AND VISUAL RESOURCES

3.8.1 Parks and Recreational Areas or Facilities on Non-Federal Lands

Figure 3.8-1 shows parks and recreation areas along the Blue Ridge Alternative and comparison portion of the proposed route. The Blue Ridge Trail System, located approximately 15 miles southeast of Coos Bay, is crossed by the Blue Ridge Alternative between approximately MPs 20.5R and 22.0R. The hiking, biking, equestrian, and motorcycle trail system is a web of trails approximately 12 miles in length which can be ridden alone or linked with gravel roads. Currently, active logging is ongoing in the area of the trail and roads are subject to closures. The proposed route segment would not affect the Blue Ridge Trail System. If the Blue Ridge Alternative were selected, portions of the trail may need to be closed during construction, similar to the trail closure for current logging activities in the area.

The only other parks in the vicinity of the proposed route and Blue Ridge Alternative are Rock Prairie and Laverne County parks. Rock Prairie County Park is an unimproved picnic-day use park located along the North Fork of the Coquille River approximately 2 miles south of proposed route at MP 22 (see figure 3.8-1). Laverne County Park is a 350-acre park located approximately 2.5 miles east of MP 22 on the Blue Ridge Alternative. The park is located on the North Fork Coquille River and encompasses Laverne County Park and West Laverne Park View Park. Laverne County Park consists of 76 campsites including 46 RV sites and 30 tent sites. West Larverne Park (Area A) caters to reserved picnics and (Area B) large group camping. The parks contain a softball field, playground, horse pits, volleyball area, hiking trails, and covered shelters. Neither the comparison portion of the proposed route nor Blue Ridge Alternative should affect park use or associated recreational opportunities.

3.8.2 Recreation, Public Interest, and Special Use Areas Specific to Consistency with Federal LMPs

There are no recreation, public interest, or special use areas managed by the Coos Bay District within the area affected by the Blue Ridge Alternative or comparison portion of the proposed route.

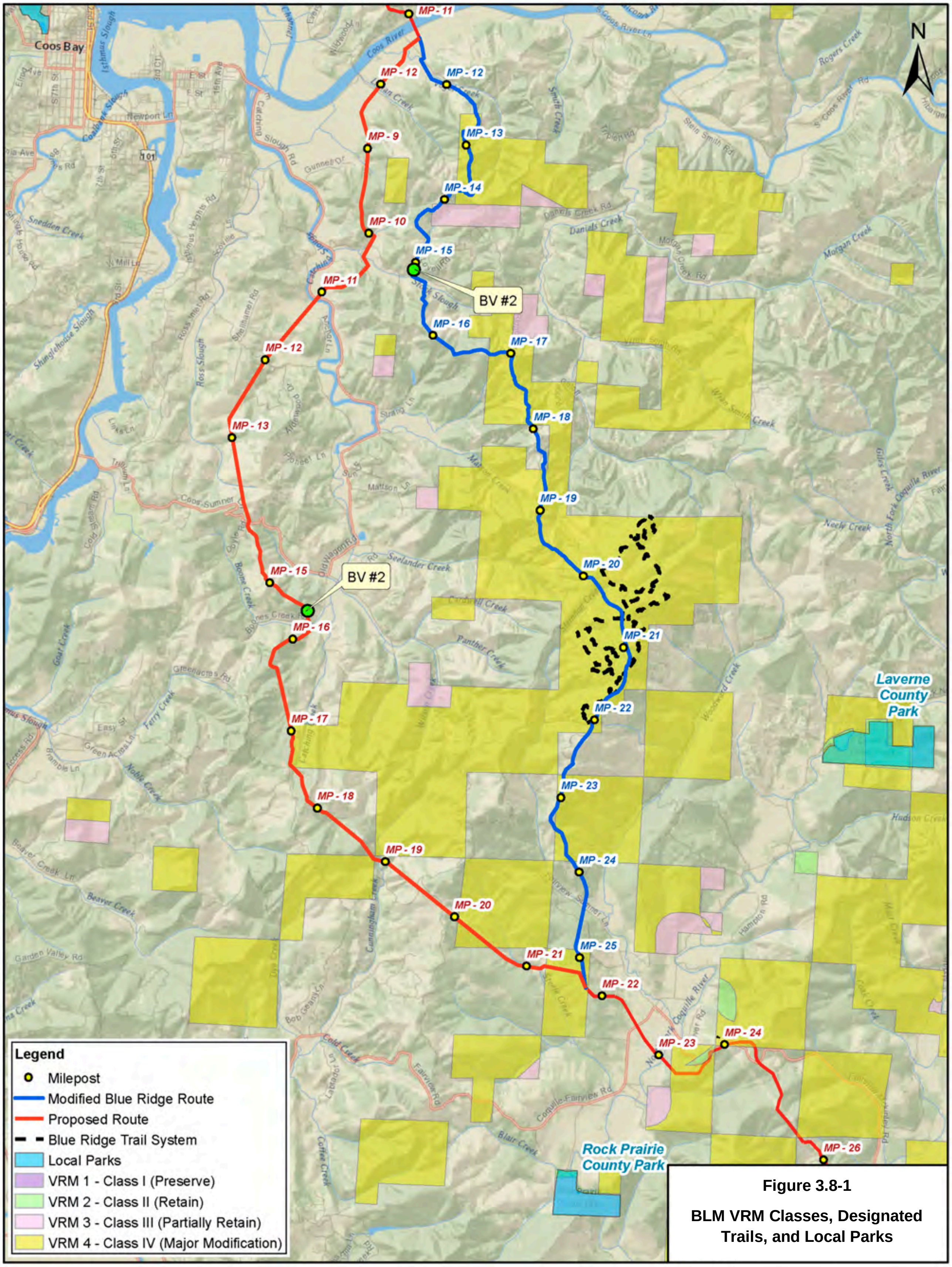


Figure 3.8-1

BLM VRM Classes, Designated Trails, and Local Parks

3.8.3 Visual Resources on Federal Lands

As shown on figure 3.8-1, the comparison portion of the proposed route would cross 1.4 miles of Visual Resource Management (VRM) Class IV (Major Modification), while the Blue Ridge Alternative would cross 7.4 miles of VRM Class IV and 0.13 mile of VRM Class III (Partial Retain). Neither route would significantly affect visual resources on federal lands.

3.9 TRANSPORTATION

3.9.1 Construction Access Roads

No temporary access roads (TARs) or permanent access roads (PARs) are proposed for the Blue Ridge Alternative. MLV #2 (MP 15.08R) is located immediately adjacent to an existing private road. The comparison portion of the proposed route does not require any TARs; however, one short PAR affecting 0.1 acre is proposed to access MLV #2 (MP 15.69).

3.9.2 Additional Traffic on Local Roads (All Jurisdictions)

It is expected that construction traffic volumes and use (i.e., heavy truck, light duty traffic, etc.) on the primary public roads connecting the comparison portion of the proposed route or the Blue Ridge Alternative with the cities of Coos Bay and Coquille and the proposed construction yards in these cities would be similar for either route. The primary public roads that would be utilized during construction of both routes include: South Coos River Road (County Road 6), Stock Slough Road (County Road 54), Fairview-Lavern Park Road (County Road 9C), and Coos Bay Wagon Road (County Road 60).

With construction of the Blue Ridge Alternative, local traffic volumes and potential effects to rural residences would be minimized or avoided along the proposed route on the following existing roads: Lillian Lane / Messerle Logging Road (Alternative MP 12.08R); private roads (Alternative MPs 10.04, 10.59, 11.33, 14.25), Raven Wood Lane (Alternative MP 10.39), Anchor Drive (Alternative MP 11.33), Eastside-Sumner-County Road 53 (Alternative MP 11.96), Alder Wood Lane & Skyline Drive, Boone Creek Road (Alternative MP 15.70), and South Sumner-County Road 58 (Alternative MP 17.40). Construction of the Blue Ridge Alternative would increase local traffic volumes and potential effects to residences located along Stock Slough-County Road-54 (MP 15.13R) above the crossing of the proposed route, as well as to residences along BLM Road 26-12-4.2 (Alternative MP 17.00R-19.68R) and private road (Alternative MP 15.7R). Further, all traffic that utilizes Daniels Tie Road (BLM 26-12-14.0) for construction of the Blue Ridge Alternative would increase local traffic volumes and potential effects to the residences along the entire length of Daniels Creek County Rd-55 and portions of Coos River Highway County Rd 241 (Alternative MP 11.07R) east of the crossing of the proposed route.

Frequent and extended road closures would be required along sections of the Blue Ridge Alternative during pipeline construction, where portions of the pipeline would be placed in the stable ridgeline beneath road surfaces. There are eight areas along the Blue Ridge Alternative where the pipeline right-of-way would encompass existing roads and where road closure would be required during construction. The corresponding area of the proposed route only has one area where existing roads are located within the construction right-of-way (i.e., Menasha Logging Spur [Alternative MP 14.60–15.01]) and where road closure would be required during construction. Pacific Connector's application does not specify work required on BLM roads; it is likely that some improvements would be required by BLM prior to use.

Pacific Connector has developed a traffic management plan that would be utilized for construction of the Blue Ridge Alternative to minimize impacts on other road users, including local and emergency traffic, as described their April 24, 2015, filing. In addition, the POD, Appendix Y (*Transportation Management Plan*), would provide the basis for managing transportation features and uses on BLM lands subject to activities associated with the Blue Ridge Alternative. The BMPs outlined in the *Traffic Management Plan* for the Blue Ridge Alternative would also be utilized where appropriate along the proposed route to minimize potential construction traffic related effects.

3.10 CULTURAL RESOURCES

3.10.1 Cultural Resources

No previously recorded archaeological resources are located within the area of potential effect of the Blue Ridge Alternative, and no newly identified archaeological resources were located during cultural survey of all federal lands between MP 11.29R and MP 23.35R. The historic Barker-Morris Families Cemetery, dating to 1872, is located on private land in Township 27 S., Range 12 W., Section 14.

The historic cemetery is situated at MP 24.3 of the Blue Ridge Alternative. However, a cultural survey has not been conducted on this privately owned parcel, and the exact location of the cemetery has not been verified. The cemetery is listed in the Oregon Burial Site Guide but has not been recorded as an archaeological site with the Oregon State Historic Preservation Office.

Similarly, no previously recorded cultural resources are located on, and no newly identified archaeological resources have been recorded in areas within the area of potential effect that have been surveyed for cultural resources on the comparison portion of the proposed route.

If the Blue Ridge Alternative were recommended, Pacific Connector would conduct further consultation with the SHPO and local area Indian Tribes regarding any potential impacts to cultural resources.

3.11 CUMULATIVE EFFECTS

3.11.1 Scope of the Analysis

The fifth-field HUC or watershed is used as the basic analysis area for cumulative effects in the EIS and is continued in this appendix. Current and reasonably foreseeable projects within the fifth-field watersheds crossed by the comparison portion of the proposed route and Blue Ridge Alternative are listed in table 4.13.2.3-1 in Chapter. In addition, the Blue Ridge Alternative would cross one watershed not crossed by the proposed route, the South Fork Coos River Watershed. Projects that may affect that watershed are included in table 3.11.1-1 below. Watersheds are shown in figure 3.11-1. For both routes, project activities would affect less than 0.1 percent of the respective watershed areas, totaling less than 1 to 3 percent when added to other identified projects and project-related mitigation on federal lands.

TABLE 3.11.1-1

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources a/ – Blue Ridge Alternative in South Fork Coos River Watershed

Activity	Project Description	Total Acres	Resources Affected	Estimated Date
South Fork Coos River Watershed				
BLM Fairview NWFP EA	Approximately 8,000 acres commercial thinning, density management, and hardwood conversion treatments in the Matrix and Riparian Reserve land use allocations (estimated that approximately 583 acres of the project could occur within the South Fork Coos River Watershed DOI-BLM-OR-CO30-2010-0001-EA (BLM, 2015) f/)	582	Forest Wildlife Riparian	Through 2018
Tioga Creek Instream Restoration Project	Place approximately 143 log / boulder structures to improve approximately 1.4 miles of spawning and rearing habitat for salmonids and other native aquatic species DOI-BLM-OR_CO30-2015-0003-DNA (BLM, 2015) b/	1.4 miles	Aquatic Riparian	2015-2020
Helipond (and Pump Chance) Maintenance	Maintain function of heliponds and pump changes at approximately 25 heliponds across the district to ensure safe entry and egress of helicopters during the water-dipping season (BLM, 2015). 2 to 4 may be maintained within the watershed	2-4	Forest Aquatic Riparian Wildlife	2017
BLM – Manual Maintenance/pre-commercial thinning	Brush and hardwood control of young stands (<11 years old). Stand density management (stands generally between 12 and 16 years old).	Unknown	Forest Wildlife Riparian	Unknown
BLM – Weed Treatment	Herbicide treatment of roadside noxious weeds	Unknown	Forest Wildlife Riparian	2016
BLM – Whiskey Train Timber Sale	Stand density management 0.6 miles of improvement 0.3 miles of renovation	52 (16 RR d/) 2 1	Forest Wildlife Riparian	ongoing (sold 2013)
BLM – Pathfinder Timber Sale	2.4 miles of new construction	6	Forest Wildlife Riparian	ongoing (sold 2014)

a/ Most future activities on private lands, such as commercial harvests, are not publically available. These activities are expected to continue at current rates.
b/ From: BLM. 2015. Coos Bay District Planning Update. Summer 2015.

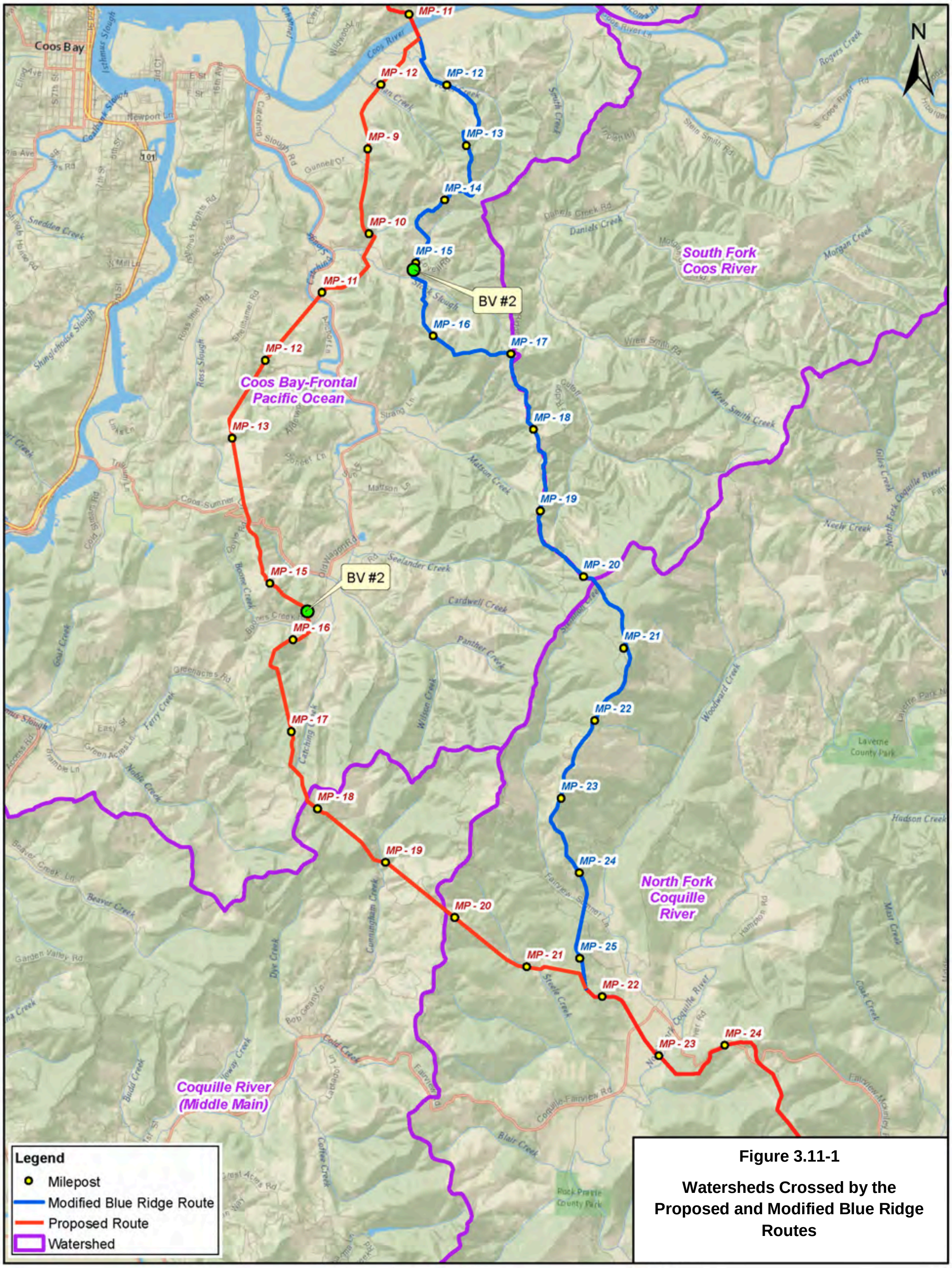


Figure 3.11-1

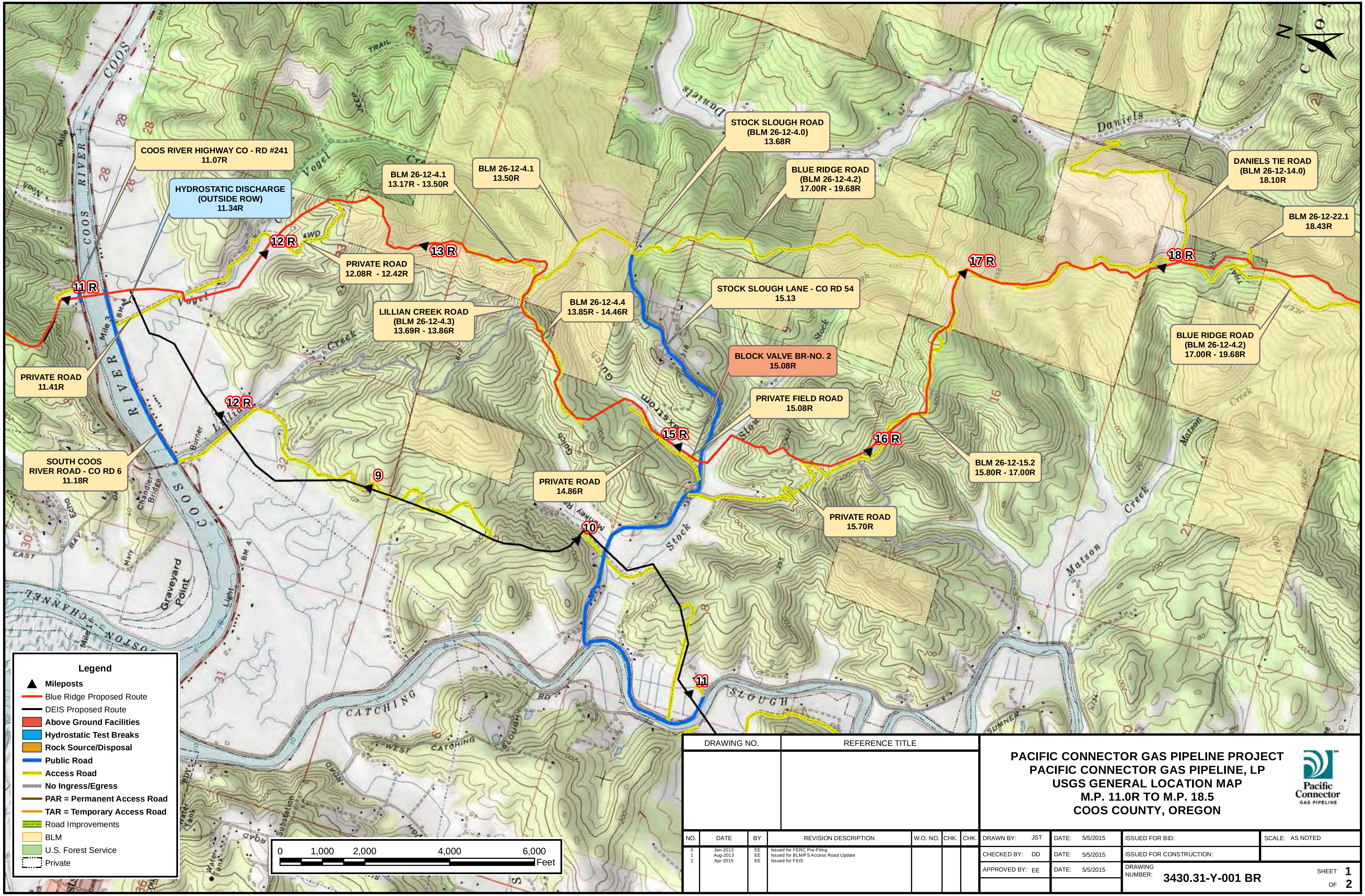
Watersheds Crossed by the Proposed and Modified Blue Ridge Routes

3.11.2 Mitigation Proposed to Offset Unavoidable Project Impacts

The BLM has not identified any environmental impacts that would necessitate off-site mitigation for the Blue Ridge Alternative.

ATTACHMENT 1

BLUE RIDGE ALTERNATIVE MAPS



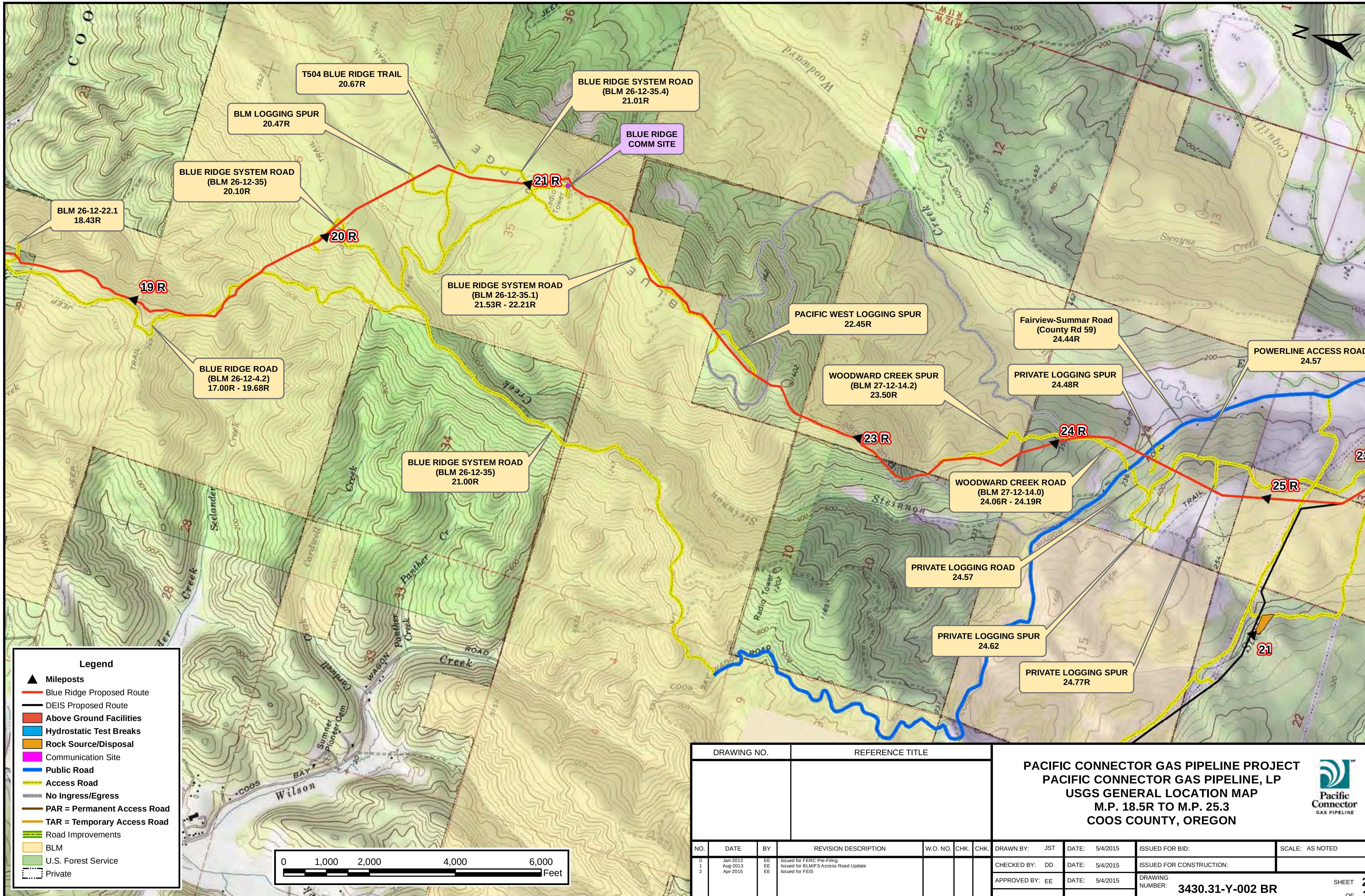
DRAWING NO.	REFERENCE TITLE

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	CHK.
0	Jan-2013	EE	Issued for FERC Pre-Filing			
1	Aug-2013	EE	Issued for BLM/FS Access Road Update			
2	Apr-2015	EE	Issued for FEIS			

PACIFIC CONNECTOR GAS PIPELINE PROJECT
PACIFIC CONNECTOR GAS PIPELINE, LP
USGS GENERAL LOCATION MAP
M.P. 11.0R TO M.P. 18.5
COOS COUNTY, OREGON

Pacific Connector GAS PIPELINE

DRAWN BY: JST	DATE: 5/5/2015	ISSUED FOR BID:		SCALE: AS NOTED	
CHECKED BY: DD	DATE: 5/5/2015	ISSUED FOR CONSTRUCTION:			
APPROVED BY: EE	DATE: 5/5/2015	DRAWING NUMBER:	3430.31-Y-001 BR	SHEET 1	OF 2



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PACIFIC CONNECTOR GAS PIPELINE PROJECT
PACIFIC CONNECTOR GAS PIPELINE, LP
USGS GENERAL LOCATION MAP
M.P. 18.5R TO M.P. 25.3
COOS COUNTY, OREGON

Pacific Connector GAS PIPELINE

DRAWN BY: JST	DATE: 5/4/2015	ISSUED FOR BID:	SCALE: AS NOTED
CHECKED BY: DD	DATE: 5/4/2015	ISSUED FOR CONSTRUCTION:	
APPROVED BY: EE	DATE: 5/4/2015	DRAWING NUMBER: 3430.31-Y-002 BR	SHEET 2 OF 2

ATTACHMENT 2

TECHNICAL MEMORANDUM FOR WATER TEMPERATURE IMPACTS ASSESSMENT

Pacific Connector Gas Pipeline Project

Blue Ridge Route Variation
Technical Memorandum for Water Temperature Impacts Assessment

Prepared for:

USDI Bureau of Land Management

Prepared by:

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(530) 222-5347
(530) 222-4958 fax
Project No. 29128-2-14

August 2015

Tables

Figures

Appendices

Acronyms

7DMA	7-day moving average
ACS	Aquatic Conservation Strategy
amsl	above mean sea level
BLM	Bureau of Land Management
cfs	cubic feet per second
CWA	Clean Water Act
FERC	Federal Energy Regulatory Commission
hydrofeatures	hydrologic features
NSR	North State Resources, Inc.
NWFP	Northwest Forest Plan
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
PCGP	Pacific Connector Gas Pipeline
PHDI	Palmer Hydrological Drought Index
PCW	Protect Cold-Water
RMP	Resource Management Plan
SNTEMP	Stream Network Temperature Model
SSTEMP	Stream Segment Temperature Model
TMDL	Total Maximum Daily Load
USFS	United States Forest Service

Chapter 1. Introduction

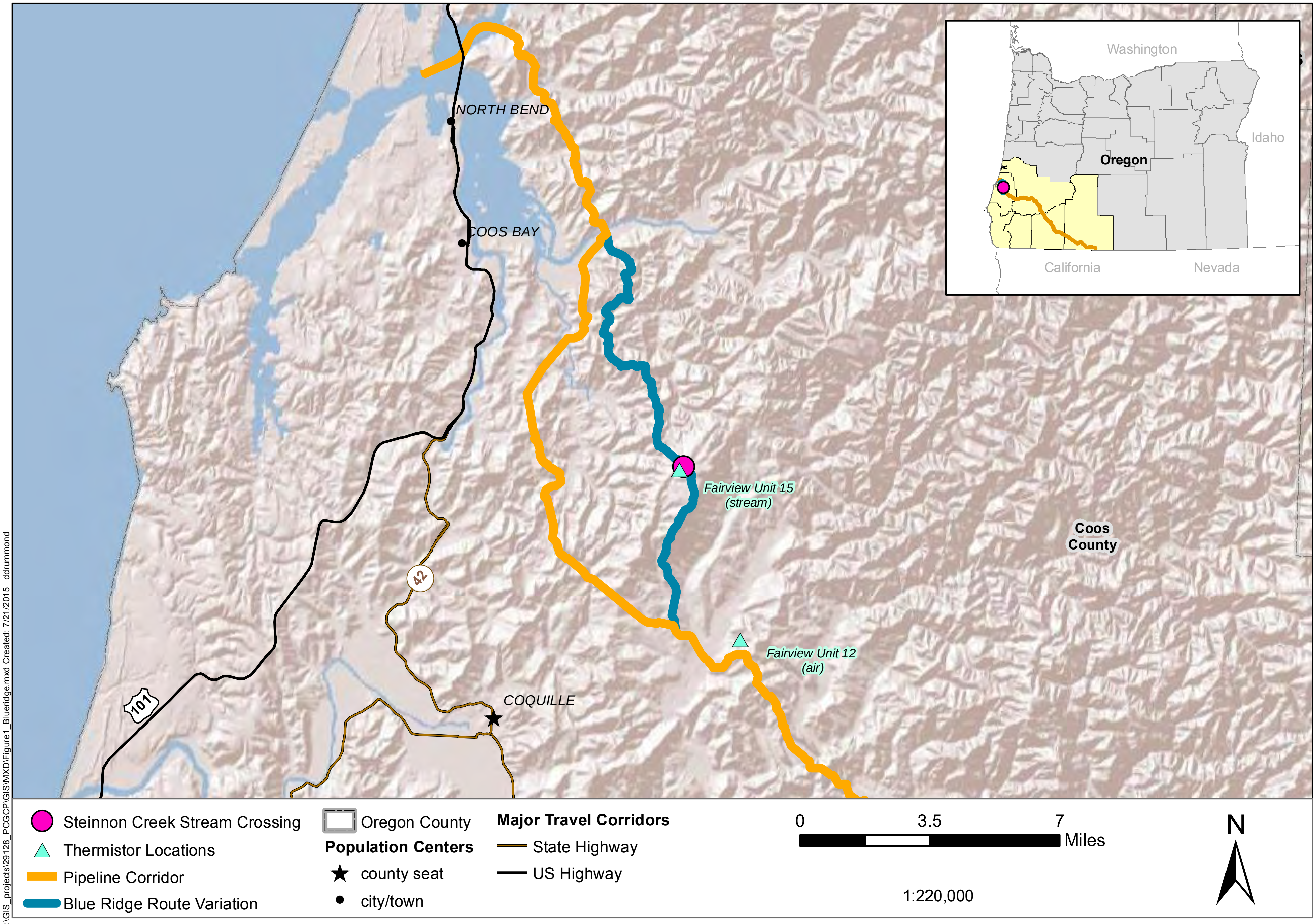
North State Resources, Inc. (NSR) prepared this technical memorandum that sets forth the scope, objectives, methods, and analytical design to be used as part of the Pacific Connector Gas Pipeline Project (PCGP Project) – Blue Ridge Route Variation water temperature impacts assessment. This technical memorandum describes the approach for collecting and analyzing the information and data necessary to conduct a stream temperature assessment at one location where the PCGP Project crosses a perennial stream on lands managed by the Coos Bay District of the Bureau of Land Management (BLM) in the South Coast Basin (Figure 1). The approach was designed to quantify the site-specific stream temperature impacts of the PCGP Project – Blue Ridge Route Variation at the Steinnon Creek crossing (MP 20.25) using two different stream temperature models. The crossing at Steinnon Creek is part of the Blue Ridge Route Variation, which is an alternate route to the proposed route considered in Federal Energy Regulatory Commission (FERC) 2014 Draft Environmental Impact Statement (EIS). The proposed route (considered in the Draft EIS) would also cross two additional perennial streams on the on lands managed by the Coos Bay District of the BLM in the South Coast Basin that were included in NSR's January 2015 assessment (North State Resources 2014):

- Middle Creek (MP 27.04); and
- An unnamed Tributary to Big Creek (Big Creek tributary) (MP 37.37).

The stream temperature assessment and modeling exercise is used to predict water temperature changes resulting from construction of the PCGP 75-foot corridor at the site in the BLM Coos Bay District (Figure 1). The results of the assessment will be used by the BLM to determine if the PCGP Project is consistent with BLM Resource Management Plans (RMPs), specifically the objectives of the Aquatic Conservation Strategy (ACS). This assessment would also be available to address the regulatory requirements of the Clean Water Act (CWA) under the jurisdiction of other federal and state agencies. Information in this assessment will also be used in FERC's Final EIS for the PCGP Project.

The key questions to be answered using results of this assessment include the following:

- What is the existing temperature regime at the site and associated stream reach?
- What are the external drivers for water temperature?
- What portion of the shade at this site is from topographic features and what portion is from riparian vegetation?
- How much effective shade would be retained after construction, and how much shade is needed to meet temperature objectives (Appendix A, Photographs 1 and 2)?
- What would be the expected change in stream temperature the first season following construction given predicted levels of effective shade?



North State Resources, Inc.

PCGP Steinnon Creek Stream Crossing Temperature Asessment

Figure 1
Steinnon Creek Stream Crossing Location

The goals of this technical memo are to document the approach and methods used to assess impacts at one perennial stream crossing and apply existing water temperature models to answer the key questions listed above.

1.1 Scope and Objectives

The PCGP Project – Blue Ridge Route Variation will cross a perennial stream on the Coos Bay District, BLM (Figure 1):

- Steinnon Creek (MP 20.25)

The Coos Bay District RMP does not set specific temperature standards for water quality. The RMP does, however, includes management direction that incorporates ACS objectives for management of the aquatic ecosystem. The ACS does not prohibit site-level impacts so long as those impacts do not prevent attainment of ACS objectives. Objective 4 of the ACS addresses water quality:

> *Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, right-of-way, reproduction, and migration of individuals composing aquatic and riparian communities.*

The PCGP Project must also comply with the CWA, which is administered by the State of Oregon. The BLM would not issue a Right-of-Way grant or otherwise authorize a project that failed to meet the standards for water quality set by the Oregon Department of Environmental Quality (ODEQ). The State of Oregon would acknowledge compliance with the CWA by issuance of a 401 certification validating that the PCGP Project met the standards for which the State is responsible.

This assessment seeks to evaluate project impacts on stream temperature in Steinnon Creek at MP 20.25 for the purpose of compliance with the Coos Bay District RMP using ODEQ temperature criteria. It is presumed that meeting ODEQ temperature criteria would also meet ACS Objective 4. A project that does not meet ODEQ criteria would likely not comply with the ACS. This document is not, however, a decision making record for ODEQ, although ODEQ may choose to review its findings.

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Chapter 2. Literature Review

2.1 Potential Impacts of Corridor Clearing on Stream Temperature

To provide context for this report, NSR reviewed available literature on the effects of corridor crossings and explored the impacts of solar radiation and shade retention on stream temperature. Measuring stream temperature is inherently complicated and results can be highly variable both spatially and temporally. Topography, slope position, aspect, and effective shade cover influence water temperatures during the summer months. Stream temperatures are also influenced by stream position in the watershed, channel condition, and volume of flow (Brown 1970). Large woody debris (LWD) influences channel condition by narrowing stream channels, creating pools, and affecting water velocity. In addition to providing shade, riparian vegetation influences microclimatic conditions through biological functions such as evapotranspiration and release of water vapor as well as through physical means such as decreasing wind speeds. Vegetation also affects bank configurations, width to depth ratios, and the exposed surface area of the stream (Johnson 2004).

Stream temperature regimes and heat budgets are complicated, and causal factors can shift with changes in biotic and geophysical conditions. Factors that are important determinants in one location may be less important in another combination of conditions (Johnson 2004). The volume of a stream, however, is particularly important in determining temperature changes in response to heat inputs. Water temperatures in small volume streams will increase more than temperatures in larger volume streams with a given amount of heat input because the concentration of heat energy is higher in smaller volume streams (Poole et al. 2001).

Whether stream temperatures are influenced by air temperature or solar radiation has been debated for years. Air temperature often correlates well with water temperature, leading some researchers to conclude that air temperature drives stream temperature. In a study of small, second-order channels in the Western Oregon Cascade Province at the H. J. Andrews Experimental Forest, Johnson (2004) concluded that solar radiation rather than air temperature was the dominant factor influencing stream temperature in small streams; air temperature and water temperature in small streams changed together because both were responding to the same daily fluctuation in solar heat inputs. This point is significant in the current analysis of Steinnon Creek; it is perennial but small in volume, similar to those analyzed by Johnson (2004). If air temperature were the dominant driver of stream temperature, then increased exposure to solar radiation at stream crossings, considered on its own, would likely have little additional impact on stream temperatures. Other conditions favoring high daily maximum stream temperatures include shallow and wide streams, north-south channel orientation, low groundwater influx or hyporheic exchange with the channel, and low gradient (Cristea and Janisch 2007).

References specific to the effect of pipeline corridors on stream temperatures are limited. Much of the available literature on corridor crossings of streams comes from administrative studies of the effects of electrical power transmission line corridor crossings on stream temperatures. While of some merit, these are not directly applicable because powerline corridors are typically much wider than pipeline corridors, and low-growing brush that provides effective stream shade can be retained in a power line corridor. This has import for the impacts of shade on water temperature and the potential to use low growing brush for effective shade, but it does not address temperature impacts from shade removal.

Tetra Tech (2013) analyzed temperature impacts from an existing powerline corridor in western Oregon. The monitored changes in 7-day moving average (7DMA) maximum water temperature showed an increase across the cleared right-of-way ranging from -0.55 to 2.82°F, with an average of 0.60°F across the 22 rights-of-way. The normalized change across rights-of-way averaged 0.19°F/100 feet. Forested control reaches of monitored streams showed more variation in temperature but normalized gradients were 0.15°F/100 feet for the 7DMA maximum water temperature. The difference between the 7DMA maximum stream temperature changes in the forested control reaches was similar to the differences found in the right-of-way reaches. Overall shading was high in nearly all tributary stream segments, including in the existing right-of-way. Based on densitometer readings, about half of the existing right-of-way clearing area had over 80 percent shade. Only three right-of-way crossings had shade less than 50 percent, with the lowest at 25 percent. This level of shading was possible since most streams were narrow and riparian area shrubs provided shade (Tetra Tech 2013). This suggests that streamside shading of small channels is effective at moderating or preventing significant temperature increases.

Unlike for powerline corridors, most of the low growing woody and herbaceous vegetation is removed for pipeline corridors because of the grading requirements for operation of machinery to trench and backfill, transport pipe segments, and lower the welded pipe into the trench. Blais and Simpson (1997) found no short- or long-term impacts on water temperature in a 3-year study in cold-water streams in New York state following right-of-way clearing for a pipeline. Given the importance of microclimate and summer weather patterns on stream temperatures (Dammann 2013, Poole et al. 2001), the conditions documented by Blais and Simpson (1997) may not be transferrable to the climate of southwest Oregon.

In a more appropriate study in terms of construction-impacts, CH2M Hill (2009) used the SSTEMP to model potential temperature changes in northwest Oregon streams from construction of a proposed natural gas pipeline similar to the PCGP. The streams analyzed were 2 to 30 feet wide with assumed flows ranging from 0.5 to 4 cubic feet per second (cfs) and a clearing width of 100 feet (CH2M Hill 2009); "worst case" scenarios for riparian clearing and the longest day of the year were assumed. Overall estimates of the increase in stream temperature ranged from 0.01°F to 1.5°F. Higher temperature changes were associated with lower flows (0.5 cfs) and larger stream channel widths (30 feet). The flows noted in this study are 2 to 18 times greater than the average low summer flows measured by BLM hydrologists and provided to NSR for use in this analysis.

In 2009, NSR modeled three stream crossings in the East Fork Cow Creek on the Umpqua National Forest using SSTEMP and the Brown model (1970). The 2009 flows were estimated using two stream discharge measurements from just upstream from the confluence with South Fork Cow Creek and the drainage-area ratio method. The pipeline corridor was modeled with zero percent effective shade and no mitigation. The results from the NSR 2009 analysis showed a maximum stream temperature increase of 3.0°F. The model results for both CH2M Hill 2009 and NSR 2009 indicate that without mitigation, small, low-volume headwater streams are likely to show temperature increases when exposed to solar radiation. This is consistent with observations by Cristea and Janisch (2007) in western Washington. In the NSR 2009 analysis of the South Fork Little Butte Creek, which is a moderate size stream (22 feet wide, with 4.2 cfs flow), the model predicted a 0.2°F maximum increase in temperature at the downstream edge of the right-of-way during maximum summer heat conditions. These differences in modeled stream temperature response highlight that low-volume channels are more responsive to exposure to solar radiation than higher volume streams.

While it is predictable that there would be some temperature increase in small channels when exposed to solar radiation, what happens to water temperatures when the water flows back into the shade below an opening is not so clearly established. For water to cool, it must dissipate heat energy. Small streams have higher temperature recovery potential than large streams because small streams are more easily shaded, have lower thermal inertia than larger streams, and are more responsive to stream cooling processes such as groundwater and cold tributary inflows (Cristea and Janisch 2007).

Johnson (2004) highlighted the importance of substrate in moderating impacts of solar radiation, noting that warmer water flowing over cooler rocks would transfer its heat and cool down. The amount of cooling would depend on the proportion of the stream flowing though the cooler substrate. Poole et al. (2001) summarized these factors that contribute to heat dissipation as follows:

> *Where water receives heat from upstream sources and flows downstream, its temperature will adjust towards the temperature of the downstream environment. Thus, added heat may dissipate from a stream if downstream conditions facilitate dissipation. Any heat that does not dissipate will be transported downstream. The distance over which heat is transported downstream depends upon the flow volume, flow velocity, groundwater interactions, groundwater temperature, air temperature, channel morphology, riparian vegetation, and many other conditions. Thus, under some circumstances, upstream heating may affect conditions only tens or hundreds of meters downstream. In these circumstances, downstream accumulation of heat may not be a problem. In other circumstances, the heat may be transported in the stream for many kilometers and therefore may contribute to a downstream accumulation of heat.*

Even without groundwater inflow and hyporheic exchange, shading can cool a small stream. In Johnson 2004, maximum stream temperature immediately responded to the placement and the removal of shade, showing the importance of incoming radiation in controlling daily maximum stream temperatures. Typically, the rate of temperature increase (change per unit of stream distance) is greater for smaller streams than for larger streams (Zwieniecki and Newton 1999). A similar relationship exists for temperature decreases. In a study conducted with timber harvest units in southwestern Oregon, temperatures downstream from limited stream-side forested clearings were found to cool rapidly once the stream re-entered forested regions (Zwieniecki and Newton 1999). Johnson (2004) also observed rapid decreases in maximum temperature where a second order stream flowed through 150 meters of total shade.

Vegetation that provides shade can recover sooner on narrower streams than on wider streams because early successional vegetation can provide as much shade as a forest canopy for bankfull widths less than 2.5 meters (Blann et al. 2002). Shade can also be provided by structural means with large logs or other organic material (e.g., slash). Jackson et al. (2001) found that the daily maximum temperature for four of seven study streams within clearcuts in the Washington Coast Range either did not change significantly or decreased following harvesting, likely due to the large volumes of slash that covered the streams and provided shade (cited in Moore et al. 2005). The NSR 2009 analysis showed that providing effective shade by planting taller conifers adjacent to the channel substantially reduced projected temperature impacts. The subsequent analysis performed and documented by NSR (NSR 2014) for perennial stream crossings on federal lands reinforced the concept that riparian vegetation (both herbaceous and conifer species) and LWD would be effective at mitigating temperature impacts to varying degrees after construction occurs.

2.2 Basic Conclusions from Literature Review

- Temperature regimes in small channels are dynamic and change rapidly both spatially and temporally with changing conditions.
- Small streams with low volumes are likely to increase in temperature when exposed to solar radiation.
- Low-growing herbaceous and woody riparian vegetation, and organic debris (construction slash, LWD) can provide effective shade for small channels during low-flow conditions.
- Small channels can quickly dissipate heat energy in tens to hundreds of meters under favorable conditions. These conditions include effective shade, a permeable substrate that allows conductive cooling, a functioning hyporheic zone that allows groundwater inflow and hyporheic exchange, cooler inputs from tributary streams, and channel morphologies that have not been over-widened.
- Water temperatures in larger valley bottom channels are less influenced by shade removal at a single location because of the thermal inertia of larger streams.

Chapter 3. Methods

Site-specific data were collected at the Steinnon Creek crossing (Blue Ridge Route Variation – MP 20.25). This crossing is also referred to as the hydrofeature in this technical memorandum. Field investigation and data collection efforts are described in the following section.

3.1 Field Investigations

All field data used in this analysis were collected and provided by BLM hydrologists and field scientists stationed in the Coos Bay District office, including stream temperature, discharge measurements, and vegetative shade estimates.

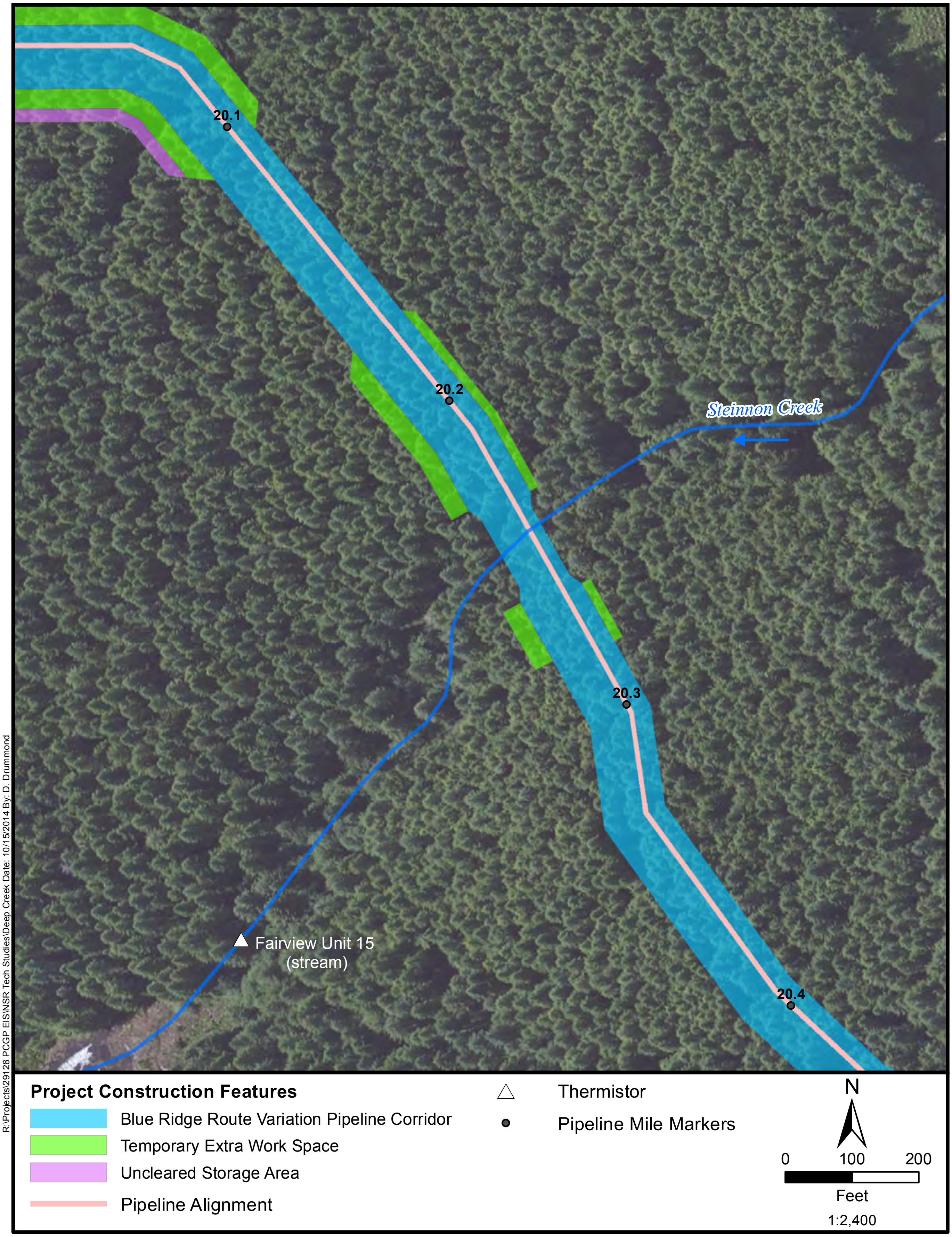
3.1.1 Stream and Air Temperature

Fortuitously, BLM hydrologists began monitoring stream temperature in Steinnon Creek in 2011 associated with other land management activities. In 2011 they installed one thermistor (Fairview Unit 15) approximately 800 feet downstream of this hydrofeature to monitor stream temperature in Steinnon Creek for an unrelated project (Figure 2).

At each site, BLM used HOBO Pro v2 Data Loggers Model U22-001 to measure stream and air temperature at 30-minute intervals at each site. This model has a rated accuracy of ±0.21°C from 0° to 50°C (±0.38°F from 32° to 122°F)). The accuracy of the thermistors was checked using a certified NIST-calibrated thermometer prior to installation. The stream thermistor was audited during the summer using a NIST-calibrated Control Company Traceable digital thermometer. The thermistors passed the OWEB and EPA accuracy checks.

Installation at the Fairview Unit 15 stream temperature site consisted of a thermistor that was zip tied to an aluminum pin inserted to the stream bank of Steinnon Creek. It was completely submerged in a lateral scour pool with rapid mixing. The sensor was placed approximately 0.5 to 0.6 feet below the stream surface and not exposed to any direct sunlight.

A thermistor was not installed at the Fairview 15 site to measure air temperature. The nearest BLM thermistor installed to monitor air temperature (Fairview Unit 12) is approximately 4.8 geodesic miles to the southeast and 1,120 feet lower in elevation than the crossing site. The air thermistor (Fairview Unit 12) is located in the same 6^{th} field watershed, Hudson Creek – North Fork Coquille River, as the stream thermistor (Fairview Unit 15). It is possible the air temperature measured at Fairview Unit 12 site is slightly different than the air temperature at the crossing site. However, this is the best available information and BLM recommended using this information in the NSR assessment. The location of the thermistors used for collecting stream and air temperatures are shown in Figure 1.



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North State Resources, Inc.

PCGP Steinnon Creek Stream Crossing Temperature Assessment

Figure 2
Steinnon Creek Stream Crossing

The Fairview Unit 15 and Fairview Unit 12 thermistors have been installed each summer, beginning of summer 2011 and collected stream and air temperature data every 30 minutes. Both thermistors were reinstalled in 2015, but that data was not available for consideration in this assessment. The 2011 through 2014 data set were used to calculate 7DMA maximum and mean water and air temperature. The 7DMA maximum and mean temperatures are the average of the daily maximum and daily mean temperatures from seven consecutive days made on a moving basis, respectively. The 7DMA maximum stream temperatures from each year were reviewed.

3.1.2 Stream Discharge

A BLM hydrologist measured stream discharge on July 9, 2015, at the hydrofeature. Stream discharge was measured during July to determine low-flow (baseflow) conditions. Due to the low-flow conditions, based on previous experience the hydrologists elected to measure stream discharge at this hydrofeature using a 5-gallon bucket. The flow in the creek was temporarily contained and routed through a PVC pipe to a graduated 5-gallon bucket. The measured discharge at the hydrofeature was 0.22 cfs.

3.1.3 Vegetation Shade

Various parameters affect the amount of shade provided by vegetation, including the slope of the stream bank, canopy cover, vegetation crown (or diameter), vegetation height, and the offset from the creek. These parameters were measured/estimated in the field by BLM staff in July 2015. A spherical densitometer was used to quantify canopy cover at the hydrofeature. The diameter of the vegetative crown was estimated. A clinometer was used to measure the slope of the stream bank and average tree height. The vegetation offset from the creek was based on visual estimates made in the field.

3.1.4 Channel Survey

The stream channel features and adjacent stream banks/hillsides at the hydrofeature were measured in the field by BLM field scientists in July 2015. The stream gradient and topographic elevation of the channel banks were measured with a clinometer. The segment azimuth was measured with a compass and Manning's n was estimated based on substrate. The wetted width of the stream was measured immediately prior to containing the flow for the discharge measurements.

3.2 Desktop Analysis

Additional data were collected from a nearby weather station and by ArcGIS analysis. Meteorological conditions at the crossings were estimated based on meteorological conditions collected at the Burnt Ridge, Oregon weather station during September 2014 (RAWS station). These data were used to estimate relative humidity and wind speed. The stream length of the hydrofeature considered in this assessment was measured from the national hydrography datasets using ArcGIS.

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Chapter 4. Site Description

The PCGP - Blue Ridge Route Variation crosses one perennial hydrofeature (Steinnon Creek) at MP 20.25 on lands managed by the Coos Bay District of the BLM. This hydrofeature is located in the Coquille Subbasin of the South Coast Basin. The Coquille Subbasin is located in southwestern Oregon near the Pacific Ocean (Figure 1). Steinnon Creek is located on the western side the subbasin, less than 14 geodesic miles to the Pacific Ocean. The crossing site is affected by the coastal weather patterns and is considered on the edge of the “fogbelt.”

The following sections describe the physical characteristics of the Steinnon Creek hydrofeature, including the channel geometry, riparian canopy and shade, stream discharge, and the existing stream and air temperatures recorded at corresponding thermistor stations.

4.1 Steinnon Creek Crossing (MP 20.25)

This hydrofeature is located near the headwaters of Steinnon Creek. The length of the hydrofeature subject that is the focus of this assessment is 77 feet at an elevation of approximately 1,400 feet above MSL (Figure 2). Steinnon Creek flows southwest into Evans Creek, a tributary to the North Fork Coquille River.

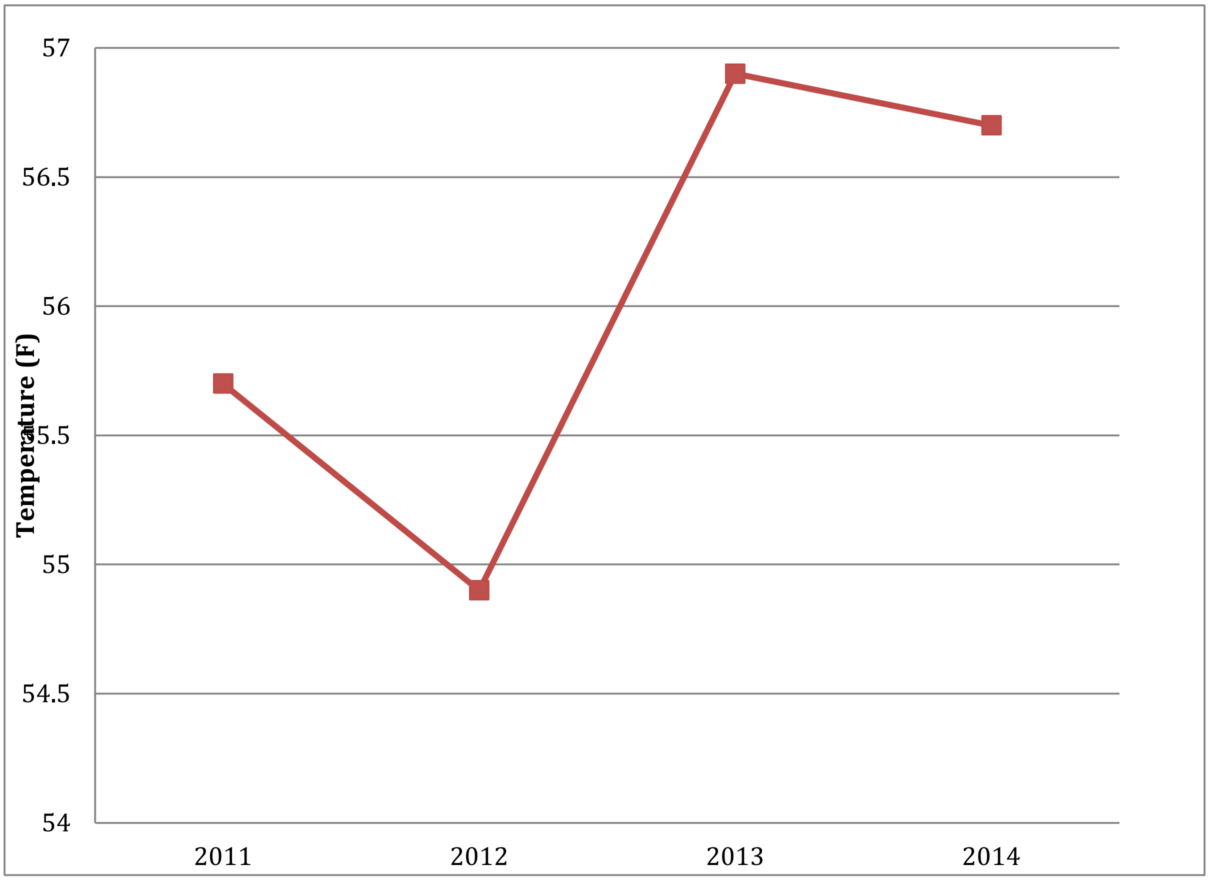
At this hydrofeature, both stream banks (east and west banks) have an average slope of 17 degrees. Given the orientation of the channel and morphology at this feature, the valley walls and stream banks do not create a lot of topographic shade during the summer.

Steinnon Creek has a perennial flow regime with an estimated base flow discharge of about 0.22 cfs during summer low-flow conditions based on measurements on July 9, 2015. The gradient of the stream averages approximately 5% in the affected reach. During the summer low-flow period, the average wetted width of this hydrofeature is approximately 6 feet and the depth is approximately 0.47 foot; however, both the depth and width vary throughout the length of crossing (Appendix A, Photograph 3). The streambed substrate consists of marine basalt bedrock, covered in areas with basalt cobble and pockets of silt. Small wood and LWD acts to shade the creek and trap substrate at the crossing site (Appendix A, Photographs 4 and 5).

The overstory vegetation associated with this hydrofeature is predominantly Douglas fir, Hemlock and Red Cedar with an average height ranging between 120 and 150 feet as estimated by BLM hydrologists during field investigations with an average canopy crown of approximately 25 feet. The understory is dominated by herbaceous and woody riparian vegetation such as Sword Fern, Oregon Grape and Salal (Appendix A, Photograph 5 and 6). The canopy cover is very dense, with an estimated 95% coverage on the west side of the creek and 90% on the east side of the creek. The riparian vegetation is set back by approximately 10 feet on west side of the creek and zero feet on the east side of the creek.

4.2 Existing Stream and Air Temperature Regime

Stream temperature was recorded in Steinnon Creek (Fairview Unit 15) by a BLM hydrologist during the summer months, beginning in 2011 and continuing until this time (Figure 1). The 7DMA maximum stream temperature data from 2011 through 2014 was compared to determine when the highest 7DMA maximum stream temperature occurred during the period of record (Figure 3). As shown in Figure 3, the highest 7DMA maximum stream temperature occurred during the summer of 2013. For this reason, stream temperature data from the summer of 2013 were used in the temperature assessment and to characterize the temperature regime of Steinnon Creek at this



hydrofeature.

Figure 3. 7DMA Maximum Temperature Data from 2011 through 2014 (reported on the 7th consecutive day) on Steinnon Creek (Fairview Unit 15)

Air temperature was not recorded near the Steinnon Creek hydrofeature. The nearest available air temperature data is recorded by the BLM at the Fairview Unit 12 site (Figure 1); it is located approximately 4.8 geodesic miles from the hydrofeature. Air temperature is also recorded at the Burnt Ridge RAWS station; however it is located approximately 19.8 geodesic miles to the east. Due to the proximity and similar site location of the Fairview Unit 12 site, the air temperature 2013 data from Fairview Unit 12 were used in the temperature assessment and to characterize the temperature regime of Steinnon Creek at the PCGP crossing location.

As shown in Figure 4, the stream temperature of Steinnon Creek does not fluctuate drastically during the summer months. From July 2 through September 22, the 7DMA maximum stream temperature of Steinnon Creek ranges between 53.5°F and 56.9°F and the 7DMA mean stream temperature ranges between 51.9°F and 55.9°F. There is also a relatively small difference in the 7DMA maximum and mean stream temperature of Steinnon Creek. Throughout the summer of 2013, the 7DMA maximum and mean stream temperatures are within 2°F of one another. The air temperature recorded at the nearby Fairview Unit 12 thermistor doesn't fluctuate drastically either. From July 2 through September 22, the 7DMA maximum air temperature ranges between 56.4°F and 76.9°F and the 7DMA mean stream temperature ranges between 62.5°F and 64.1°F. The cool air temperatures are likely a result of the coastal influence.

Based on water temperature data collected near the hydrofeature at Fairview Unit 15 during Summer 2013, the highest daily average water temperature was 57.9 ºF, which was recorded on September 10. The maximum stream temperature recorded was 59.2°F, also on September 10. As shown in Figure 4, the highest 7DMA water temperatures were recorded during the same period in September of that year. The highest 7DMA maximum and mean water temperatures were 56.9ºF (September 7–13) and 55.8ºF (September 7–13), respectively. .

As shown in Figure 4, the 7DMA air temperature recorded at Fairview Unit 12 and the 7DMA stream temperature at Fairview Unit 15 exhibit similar patterns; the peaks and dips occur at the same time. While the timing of the peaks and dips are similar, the magnitude of the peaks and dips vary between the stream and air temperature. The maximum 7DMA air and stream temperature do not occur at the same time in the summer. The 7DMA maximum air temperature was 76.9°F recoded from June 26-July 2 at Fairview Unit 12. The 7DMA maximum air temperature from September 7 -13, 2013 was 71.0°F. The highest daily average air temperature from September 7 -13, 2103 was 62.3°F (September 9), which is approximately 2.9°F lower than the highest average temperature of the summer (65.2°F on July 18). The maximum air temperature from September 7-13 was 75.3°F, which is approximately 4.6°F less than the highest air temperature recorded during the summer of 2013 (79.9°F on June 29). As discussed in Chapter 2 - Literature Review, various other factors besides air temperature can affect stream temperature, including hyporheic exchange, stream width and depth and stream orientation.

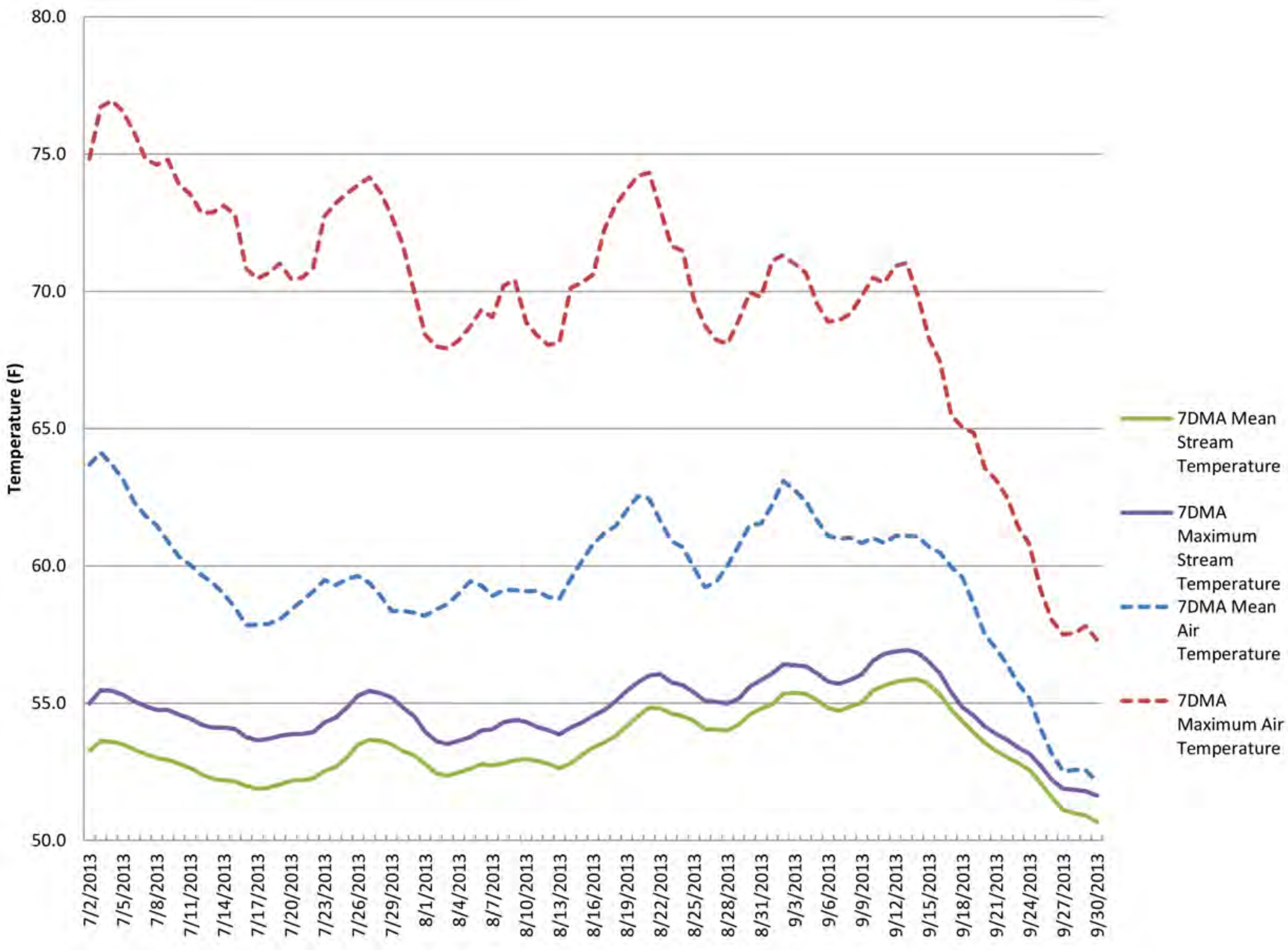


Figure 4
7DMA Mean and Maximum Temperature (reported on the 7th consecutive day) at Fairview Unit 12 (air) and Fairview Unit 15 (stream)

Chapter 5. Stream Temperature Models

Water temperature dynamics are complex, and it is often difficult to accurately quantify a heat budget without extensive empirical data. Various published models (e.g., Brown 1970 and Theurer et al. 1984) can be used to characterize and quantify the driving factors for water temperature dynamics and to estimate the potential changes in water temperature when one or more of the factors are altered (e.g., riparian vegetation is removed). Several models were considered in this updated analysis, including Brown (1970), Stream Network Temperature Model (SNTEMP), SSTEMP, and HeatSource. Using the approach similar to the assessments performed by NSR in 2009 and 2014, two models were used to quantify changes in water temperature, the Brown model (1970) and SSTEMP Version 2.0 (Bartholow 2002). The following sections describe the models, input variables, and model analysis.

5.1 SSTEMP Model

The SSTEMP model was used to predict the 7DMA maximum stream temperature (Bartholow 2002), as a function of stream distance and environmental heat flux. The SSTEMP model is based on the dynamic temperature-steady flow equation (Bartholow 2002) and can be used to predict the stream temperature changes resulting from removing effective shade. The model estimates the net heat load, factoring topographic and vegetative shade; calculates net solar radiation input to the wetted stream channel; and predicts the resulting water temperature.

For this model, the key elements of water temperature dynamics used to calculate the change in temperature include (see Appendix B):

- Channel geometry: segment length, channel slope, wetted channel width, elevation, and channel roughness. The channel slope, wetted channel width and channel roughness were collected at the hydrofeature by BLM field scientists in July 2015. The segment length and elevation were measured from ArcGIS.

- Hydrology: stream discharge and temperature. No stream discharge data was available for Steinnon Creek in 2013. Stream discharges was recorded on July 9, 2015 and used in the analysis. The 7DMA maximum water temperature from September 7–13, 2013 for Steinnon Creek was used for the existing condition stream temperature.

- Shade: topographic altitude (stream bank slope), vegetation height, vegetation density, vegetation crown, and vegetation proximity to the channel. BLM field scientists measured these variables in the field in July 2015.

- Meteorology: air temperature, relative humidity, wind speed, and ground temperature. The highest daily average air temperature recorded at Fairview Unit 12 during the 7DMA maximum stream temperature period (September 7- September 13, 2013) was used in the model. Relative humidity was calculated based on the average relative humidity measured at the Burnt Ridge RAWS weather station on September 09, 2013. The wind speed is based on average wind speeds recorded at the Burnt Ridge RAWS station from September 7–13, 2013.

The mean air temperature measured at Fairview Unit 12 from June 26, 2013 through November 24, 2013 was used as the average ground temperature (per SSTEMP model directions).

- Time of the year: September 9, 2013.

5.2 Brown Model

Brown (1970) developed an empirical equation to predict the maximum changes in water temperature following clear-cut timber harvest along small, forested streams. The equation for predicting the water temperature change is based on field experiments conducted in the Umpqua Basin in Oregon (e.g., Brown et al. 1971). The predicted equation should only be applied to stream segments less than 2,000 feet in length and is only relevant for complete removal of shade by clear cutting (Brown 1969). The equation calculates the water temperature change as a product of the net heat load to the wetted stream channel times the wetted channel planar area divided by the base flow discharge where:

$$\Delta T = H*A/Q*0.000267$$

where,
ΔT = maximum water temperature change (°F)
H = net solar radiation (BTU/ft^2/min)
A = wetted channel planar area (ft^2)
Q = base flow discharge (cfs)

The Brown model requires far fewer variables than the SSTEMP model. The segment length, wetted width, stream temperature, discharge, and solar radiation for the area are required. The values used in the SSTEMP model for segment length, wetted width, stream temperature, and discharge were also used in the Brown model. The average solar radiation was calculated and averaged for September 7 through September 13, using the ArcGIS solar radiation tool.

5.3 Model Analysis

This analysis quantified existing (pre-project) conditions to provide a basis for comparing post-project impacts on stream temperature. The SSTEMP and Brown models were used to create realistic temperature models for the hydrofeature under existing conditions. The 7DMA maximum stream temperature (56.9°F) recorded at Fairview 15 on Steinnon Creek from September 7–13, 2013 was used as the existing conditions. The stream temperatures recorded during this 7-day period are the highest temperatures to occur in Steinnon Creek from 2011 through 2014. As discussed above, air temperature data from nearby (same 6th field subwatershed) thermistor site (Fairview Unit 12) was used in the analysis. The mean air temperature on September 9, 2013 (62.3°F) was the highest recorded at Fairview Unit 12 during the 7-day period. While higher air temperature was recorded at Fairview Unit 12, they did not coincide with the maximum 7DMA stream temperature of Steinnon Creek. Stream discharge was not recorded during the 7-day period of maximum stream temperature.

Stream discharge was measured on July 9, 2015 (0.22 cfs) and used in the both models. While the stream discharge may generally be higher in July than September, this may not have been the case during in July 2015 and September 2013. According to the Palmer Hydrological Drought Index (PHDI) for Long-Term l Conditions (NOAA, June 2015), the southern coastal region of Oregon is currently in severe drought (July 2015). During September 2013, when the maximum 7DMA stream temperature was recorded, the PDHI maps indicate that the southern coastal region of Oregon was experiencing mid-range hydrological conditions (neither drought nor wet conditions) (NOAA, September 2013). This might imply that stream flows were average during September 2013 and lower than average during July 2015; and the discharge measured in July 2015 (under drought conditions) may align with the discharge that occurred during September 2013 (under mid-range conditions).

The effective shade under the existing condition was calculated by SSTEMP based on site-specific estimates provided by BLM field scientists. The SSTEMP-modeled stream temperature was compared to the measured stream temperature data under existing conditions to validate the model. The Brown model does not take into account shade, so it was not possible to validate the model under existing conditions. The Brown model results were compared to the SSTEMP results.

The temperature models were used to predict the effects on stream temperature of removing various levels of riparian vegetation along the 75-foot PCGP corridor associated with the hydrofeature. Changes in environmental conditions are measured from the existing condition. For the purposes of this modeling exercise, three different shade levels corresponding to various resonation levels were considered. It should be noted that effective shade does not include topographic shade, but may include shade produced from large woody debris, boulders, slash, etc.).

- 0% effective shade: This represents the post-construction condition with no mitigation. The PCGP corridor would resemble a road when construction clearing is completed (Photograph 2). Since the corridor must be excavated to a nearly flat surface for the operation of equipment, little of the existing riparian vegetation would be retained within the 75-foot construction corridor.
- 50% effective shade: At this hydrofeature, this would be accomplished by placement of LWD, boulders, possible shade structures, planting larger conifers, and planting fast-growing riparian vegetation typical of the site such as salal, salmonberry and sword ferns.
- 75% effective shade: At this hydrofeature, this level of shade would be accomplished by additional LWD and denser vegetative planting.

The hydrofeature was analyzed to characterize and quantify the potential direct effects of constructing the PCGP crossing at this specific location using the 7DMA maximum stream temperature as the metric. Both the SSTEMP and Brown models were used to predict the 7DMA maximum stream temperature change under the most drastic conditions, consisting of complete removal of riparian vegetation along the 75-foot corridor (0% effective shade). The results from the Brown model were then compared to results from the SSTEMP model (0% effective shade). Due to the limited capability of the Brown model, only the SSTEMP model was used to quantify the stream temperature impacts with 50% and 75% effective shade. Modeled stream temperature impacts at for this hydrofeature under the three shade scenarios were compared to the ODEQ water quality standards for stream temperature to measure compliance. The applicable ODEQ water quality standards for the PCGP crossings site at Steinnon Creek is described in the following section.

5.4 Compliance with ODEQ Water Quality Standards

The State of Oregon through the ODEQ in cooperation with the federal Environmental Protection Agency (EPA) is responsible for establishing water temperature standards. These are published in the Oregon Administrative Rule (OAR) 340-041 Water Quality Standards: Beneficial Uses, Policies and Criteria for Oregon.

Table1 describes the current regulatory status of Steinnon Creek with respect to ODEQ water temperature criteria.

Table 1. ODEQ Water Quality Standards for Steinnon Creek

Crossing / Watershed	Status	Comments
Steinnon Creek, MP 20.25/ North Fork Coquille River	▪ Salmon and Steelhead Spawning Use, October 15 to May 15 (middle and lower reach) ▪ Salmon and Trout, Rearing and Migration ▪ Tier 2 waterbody under ODEQ Antidegradation Policy	TMDL for temperature not established for North Fork Coquille River watershed. Existing baseline temperatures in Steinnon Creek (13.8°C) is below thresholds for Salmon and Trout Rearing and Migration (18°C).

5.4.1 Antidegradation Policy

Since a TMDL allocation for temperature has not been established for the North Fork Coquille River, criteria for potential water temperature impacts from crossings of perennial streams in these watersheds would fall under the Antidegradation Policy of the State of Oregon.

Based on OAR 340-041-0026(3)(a)(F)(ii), an activity that results in more than a 0.25°F (0.14°C) change in temperature (at the edge of the mixing zone, if existing) will constitute a lowering of water quality. This limit comes from the rule restriction for Water Quality Limited Waters. For consistency, this limit will be applicable to activities in all classes of waters.

5.4.2 Protect Cold-Water Criteria

It is the policy of the State of Oregon that new sources of thermal impacts and activities may not cumulatively increase the 7DMA stream temperature of high-quality cold-water reaches (those that stay below the numeric criteria (18°C) all summer) by more than 0.3°C (0.5°F) above the current ambient summer maximum temperature. This is referred to as the Protect Cold-Water (PCW) criteria. The 7DMA stream temperature of Steinnon Creek (56.3°F, 13.8°C) at the hydrofeature is below the numeric criteria so the PCW standards would apply.

5.4.3 Synthesis of ODEQ Water Quality Criteria

Since the Antidegradation Policy threshold of 0.25°F (0.14°C) is less than the allowable increase of the PCW criteria (0.3°C, 0.5°F), conformance with the Antidegradation Policy would also meet the PCW criteria. The BLM would consider project impacts that meet ODEQ water quality standards as complying with Objective 4 of the ACS as related to temperature. (See Section 1.1 of this paper for a discussion of ACS Objective 4.)

Chapter 6. Model Results

The stream temperature impact at the hydrofeature was modeled with the SSTEMP and Brown models. The SSTEMP model was used to quantify the stream temperature change at selected shade levels. The Brown model was used only to quantify the stream temperature change at 0% shade level.

6.1 SSTEMP Model Validation

In order to validate the SSTEMP model, the hydrofeature was modeled under existing conditions on September 09, the warmest recorded day from September 7 through September 13, 2013. The 7DMA maximum recorded water temperature during this time period was compared to the modeled 7DMA maximum temperature. The results are shown in Table 2.

Table 2. SSTEMP Model Validation

Crossing	Thermistor	Measured 7DMA Maximum Temperature (Existing Condition) (°F)	Modeled 7DMA Maximum Temperature (°F)	Temperature Difference (°F)
Steinnon Creek	Fairview Unit 15	56.9	56.9	0.0

As shown in Table 2, the SSTEMP model was able to predict the 7DMA maximum temperature within 0.0ºF of the measured 7DMA maximum temperature at the hydrofeature.

6.2 SSTEMP Stream Temperature Impacts

SSTEMP calculates the average shade provided by vegetation and topography, based on stream orientation, topographic altitude, vegetation height, crown, offset, and density. Based on the data collected in the field and the SSTEMP model results, Steinnon Creek has 95% total shade with less than 1% from topography. These values are the average shade values for the length of the hydrofeature. The total shade at various points along the hydrofeature length varies, based on such factors as vegetative cover, vegetative height, and stream bank angle.

The SSTEMP modeled stream temperature impacts due to a reduction in shading at the hydrofeature are shown in Table 3. The results are estimates of the stream temperature differences at the crossing due to construction of the PCGP Project- Blue Ridge Route Variation. The temperature impacts do not reflect observed downstream cooling from the stream reentering shaded areas, hyporheic exchange, inputs from other channels, or cooling from evaporation. These modeled results should be not construed as a systemic change in water temperature that persists downstream.

As described in Section 5.3, Model Analysis, the PCGP Project- Blue Ridge Route Variation would result in a reduction in shading from the existing conditions to 0% shade at the time of construction, with no mitigation. As shown in Table 3, with 0% effective shade, the modeled 7DMA maximum temperature of Steinnon Creek at the hydrofeature would increase by 0.4ºF (0.2ºC) to 57.3ºF (14.1ºC). Modeling construction impacts with no mitigation provides a maximum impact assessment.

Table 3. SSTEMP Model Results for 0% Shade, 50% Shade, and 75% Shade*

Hydro-feature	Existing Condition Temperature	Modeled Post Construction Temperature % Shade*			Difference in Modeled Post-Construction and Existing Preconstruction Temperatures % Shade		
		0%	50%	75%	0%	50%	75%
Steinnon Creek (°F)	56.9	57.3	57.1	57.0	0.4	0.2	0.1
Steinnon Creek (°C)	13.8	14.1	13.9	13.9	0.2**	0.1	0.06

Shade percentage does not include shade from topographic features*Due to rounding.

As shown in Table 3, the 7DMA maximum stream temperature at the hydrofeature is expected to increase from 56.9°F (13.8°C) to 57.1°F (13.9°C) with 50% vegetative shade. Thus, a reduction in the existing vegetative shade level of 95% to modeled shade level of 50% causes a predicted increase of 0.2°F (0.1°C) at the crossing site. LWD and salal, salmonberry and sword fern plantings would be used to reestablish shade at the hydrofeature immediately after construction of the crossing.

With 75% shading at the hydrofeature, the shade level is slightly less than pre-project (existing) condition, causing a slight increase in stream temperature at the hydrofeature. As shown in Table 3, the 7DMA maximum stream temperature at the hydrofeature is expected to increase 0.1°F (0.06°C) from 56.9°F (13.8°C) to 57.0°F (13.9°C) with 75% vegetative shade.

6.3 Brown Model Results

The results from the modeling with the Brown equation show a 7DMA maximum stream temperature increase at the hydrofeature due to complete removal of vegetation (Table 4). The Brown model does not take into account shading created from topographic features; with this model, the hydrofeature is considered completely exposed to solar radiation. The existing condition temperature is based on the measured 7DMA maximum at the corresponding thermistor (Fairview Unit 15).

Table 4. Brown Model Results and Comparison with SSTEMP (0% Veg Shade) Results

Hydrofeature	Existing Condition Temperature	Brown Modeled Temperature	Brown Difference	SSTEMP Difference (0% Veg Shade)	Brown-SSTEMP Difference
Steinnon Creek (°F)	56.9	57.4	0.5	0.4	0.1
Steinnon Creek (°C)	13.8	14.1	0.3	0.2	0.07

Similar to the SSTEMP model results, the Brown model predicts a slight increase in stream temperature under the worst case conditions, complete removal of vegetation. With zero shade at the hydrofeature, the 7DMA maximum stream temperature is predicted to increase by 0.5 ºF (0.3ºC) to 57.4ºF (14.1 ºC).

As shown in Table 4, the predicted temperature changes (for zero percent shade) at the hydrofeature is similar for both the Brown model and the SSTEMP model. The Brown model predicts a slightly greater increase in the 7DMA maximum stream temperature at the hydrofeature than the SSTEMP model. There is a 0.1ºF difference in the Brown and SSTEMP modeled 7DMA maximum stream temperature. As noted above, unlike the SSTEMP model, the Brown model does not include shading from topography, however; the shading from topography is estimated to be 1% or less.

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Chapter 7. Discussion and Interpretation

The Brown model and the SSTEMP models were used to quantify the potential 7DMA maximum stream temperature increase from exposure to solar radiation, if all vegetation was removed at the Steinnon Creek hydrofeature. The Brown model does not take into account shading created from topographic features; with this model, the stream segment is considered completely exposed to solar radiation, while the SSTEMP model includes topographic shading. However, at the hydrofeature the modeled shading from topography is less than 1%. The results from the two models were compared to assess the potential stream temperature impacts (Table 4). The Brown model predicted slightly higher increases in stream temperature than the SSTEMP model. Based on the Brown model results, the 7DMA maximum stream temperature at the hydrofeature crossing will increase by 0.5 ºF (0.3ºC), from 56.9ºF (13.8 ºC) to 57.4ºF (14.1 ºC). The SSTEMP model predicted a slightly lower increase in the 7DMA temperature (0.4°F, 0.2°C).

Results of the SSTEMP and Brown modeling indicate that with 0% effective shade retention (construction impacts with no mitigation), the modeled 7DMA maximum stream temperature increase of 0.4°F-0.5°F (.2°C - 0.3°C) at the hydrofeature does exceed the Antidegradation Policy threshold of 0.25°F (0.14°C). However, the expected change in the 7DMA maximum stream temperature does not exceed the PCW threshold of 0.5°F (0.3°C).

The SSTEMP model was used to predict the expected change in the 7DMA stream temperature at the hydrofeature with different shade levels. With 50% effective shade established at the hydrofeature, the 7DMA stream temperature is expected to increase 0.2°F (0.1°C). The PCW criteria (maximum stream temperature increase of 0.5°F, 0.3°C) and the Antidegradation Policy threshold (maximum stream temperature increase of 0.25°F, 0.14°C) will both be met under these conditions. With 75% effective shade established at the Steinnon Creek crossing, there are very minimal impacts to the stream temperature (0.1°F, 0.06°C) and clearly both the PCW criteria and the Antidegradation Policy threshold will be met.

Based on the SSTEMP modeling results, at least 50% effective shade needs to be attained at the hydrofeature to meet ODEQ temperature standards at these low flows. Establishing 50% effective shade can easily be achieved and possibly surpassed by placement of large wood/boulders, planting larger conifers, and planting lush riparian vegetation such as salal, salmonberry, and sword fern. As shown in Photograph 5 (Appendix A), there is an abundant source of small wood, shading the creek and trapping substrate, at the crossing site. Placing small wood post-construction would help shade the creek, raise the stream bed, and promote some hyporheic exchange. This channel is narrow and LWD, boulders, planted trees, and shrubs can create extensive and effective shade. As noted by Blann, vegetation that provides shading can recover sooner on smaller streams than on wider streams because early successional vegetation can provide as much shade as a forest canopy for bankfull widths of less than 2.5 meters (Blann et al. 2002). These model outputs represent low-flow conditions; any increase in flow volume will reduce the impacts of solar exposure.

For a given level of solar radiation, stream temperature is inversely proportional to volume (Brown and Krygier 1970). As a result the temperature patterns of small shallow streams typical of headwater regions may be increased significantly by any changes in the solar radiation (Brown 1970). The stream volume in this analysis is low. The discharge in Steinnon Creek was measured in July 2015, when flows were low, after an extremely dry winter in Oregon. According to the PHDI for Long-Term Hydrological Conditions (NOAA June 2015), the southern coastal region of Oregon was in severe drought June 2015. Any increase in stream volume would have a significant beneficial effect on stream temperatures when stream surfaces are exposed to solar radiation. In other words, the same amount of exposure to solar radiation would have a lower impact in a wetter or more average water year.

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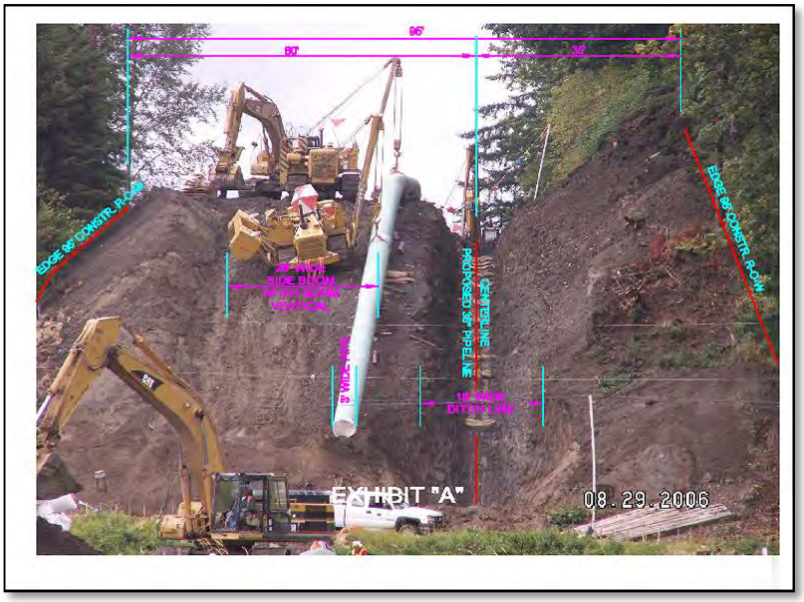
APPENDIX A

Site Photographs

Appendix A: Hydrofeature Photographs

North State Resources, Inc. (NSR.29128)



Photograph 1. Typical pipeline construction within right-of-way.

Photograph 2. Typical pipeline right-of-way corridor through sloped and forested terrain.

Photograph 3. Steinnon Creek near the centerline of proposed pipeline crossing (compliments of BLM, July 2015).

Photograph 4. Steinnon Creek channel substrate (compliments of BLM, July 2015).

Photograph 5. Douglas fir, Western Hemlock, Salal and Sword Fern dominate the vegetation along Steinnon Creek (compliments of BLM, July 2015).

Photograph 6. Steinnon Creek – stream channel and riparian vegetation at the downstream end of proposed pipeline crossing (compliments of BLM, July 2015).

APPENDIX B

2013 Site Data

2015 Steinnon Creek Site Data	Blue Ridge
Location (Lat, Long)	43.28, -124.09
Stream Segment Length in ROW (ft)	77
Stream Segment Length in ROW (MILES)	0.0146
Upstream Elevation	1405
Downstream Elevation	1400
Maximum Air Temperature (°F) (Sept. 10)	75.3
Maximum Summer Air Temperature (°C)	24.1
Average Air Temperature (°F) (Sept. 9)	62.3
Average Air Temperature (°C) (Sept. 9)	16.8
Average Relative Humidity (%)	57
Average Relative Humidity of segment (%)	72
Average Wind Speed (mph)	6.5
Ground Temperature (°F)	55.8
Thermal gradient (j/m²/s/C)	1.65
Possible Sun (%)	50
Dust Coefficient	4
Ground Reflectivity (%)	15
Solar Insolation for area (WH/m^2) (from GIS)	4188
Valley	
Aspect of Valley (0 -360) us -ds (segement azimuth deg)	80
Left Bank - Avg Side Slope- (degrees)	17
Right Bank- Avg Side Slope- (degrees)	17 degrees
Stream Channel	
Base Flow Discharge (cfs)	0.22
Date of Base Flow Discharge	7/9/2015
7DMA Maximum Water Temperature (°F)	56.9
Date of 7DMA Maximum Water Temperature	09/13/13
Maximum Water Temperature (°F)	59.2
Wetted Width (ft)	6
Average Wetted Depth (ft)	0.57
Maximum Wetted Depth (ft)	0.7
Substrate Description	marine basalt bedrock covered in areas with basalt cobble and pockets of silt
Large Woody Debris (volume m^3)	4.5
Stream Gradient (%)	500%
Mannings n	0.035-0.04
Riparian Vegetation Type - Left Bank	Douglas-fir w/ hemlock and redcedar, sword fern and salal understory
Riparian Vegetation Type - Right Bank	Douglas-fir w/ hemlock and redcedar, sword fern and salal understory
Riparian Vegetation Canopy Height (ft) - Left Bank	120-150
Riparian Vegetation Canopy Height (ft) - Right Bank	120-150
Riparian Vegetation Canopy Closure (%) - Left Bank	95
Riparian Vegetation Canopy Closure (%) - Right Bank	90
Riparian Vegetation Crown Diameter (ft) - Left Bank	25
Riparian Vegetation Crown Diameter (ft) - Right Bank	25
Average shade-producing vegetation offset from stream bank (ft) - Left Bank	0
Average shade-producing vegetation offset from stream bank (ft) - Right Bank	10

ATTACHMENT 3

SITE-SPECIFIC STREAM CROSSING PRESCRIPTION FOR STEINNON CREEK

Pacific Connector Gas Pipeline Project

Attachment 3 to Appendix Q
Blue Ridge Route Variation
Technical Memorandum

Site-Specific Stream Crossing Prescription for Steinnon Creek

Prepared for:

USDI Bureau of Land Management

Prepared by:

North State Resources, Inc.

August 2015

Pacific Connector Gas Pipeline Project

Technical Memorandum

Site-Specific Stream Crossing Prescriptions for Perenial Streams on BLM System Lands
Blue Ridge Route Variation:
Steinnon Creek Stream Crossing

Prepared for:

USDI Bureau of Land Management

Prepared by:

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Project No. 29128

August 2015

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Acronyms

BLM	Bureau of Land Management
EIS	Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
MOU	Memorandum of Understanding
MP	Milepost
NSR	North State Resources, Inc.
ODFW	Oregon Department of Fish and Wildlife
ODEQ	Oregon Department of Environmental Quality
PCGP	Pacific Connector Gas Pipeline, LLC
POD	Plan of Development
ROW	Right of Way

Section 1. Introduction and Purpose

1.1 What This Document Does

This document was completed by North State Resources, Inc. (NSR) at the request of the Bureau of Land Management (BLM). The intent of this document is to provide a crossing prescription for a perennial stream, Steinnon Creek, crossed by the Pacific Connector Gas Pipeline (PCGP) - Blue Ridge Route Variation, which is an alternate route to the proposed route considered in Federal Energy Regulatory Commission (FERC) 2014 Draft Environmental Impact Statement (EIS). Steinnon Creek which is located on BLM land at Milepost (MP) 20.25 of the Blue Ridge Route Variation.

This supplemental document provides a stream crossing plan and prescription for the Steinnon Creek stream crossing that is consistent with the methods of previous technical memorandum Site-*Specific Stream Crossing Prescriptions Perennial Streams on BLM and National Forest System Lands (NSR 2014)*. A restoration plan and the desired condition for the Steinnon Creek crossing is also included in this document. The desired condition for the crossing is consistent with the Aquatic Conservation Strategy as outlined in BLM's Coos Bay District Resource Management Plan (RMP). This prescription incorporates supplemental information from PCGP Addendum #2 to Response to May 22, 2015 BLM Data Request (PCGP 2015), limited site-specific reviews, and local knowledge and experience of the local BLM staff (hydrologist, planner). Site-specific information on topography, vegetation and channel morphology was provided by BLM staff from the Coos Bay District.

The prescription in this document is intended to FERC's Wetland and Waterbody Crossing and the applicants Plan of Development if the project is authorized. This document will also become an attachment to appendix Q of the Final EIS as supporting documentation of the analysis of the Blue Ridge Alternative.

It is expected that this prescription provides the starting point for the pre-construction crossing review at the perennial stream crossing. These prescriptions would be conditions of the ROW Grant if authorized. As such, changes in this prescription may be made if agreed in writing by the appropriate Agency representative based on the on-site conditions at the time of construction or new information that may arise during the course of construction surveys.

1.2 What This Document Does Not Do

No part of these prescriptions is intended to preempt pipeline engineering, design, construction and safety considerations that are not the expertise of the BLM.

1.3 General Set of BMPs

Table 1.3-1 provides a general set of BMPs based on the crossing rating of "yellow" (moderate risk) developed by GeoEngineers for the Stream Crossing Risk Analysis (GeoEngineers 2013). The stream crossing rating for Steinnon Creek determined by GeoEngineers is an addendum to a 2015 data request by the BLM (PCGP 2015) and is discussed in the following section of this document. Note that not all

BMPs on Table 1.3-1 are applicable to the Steinnon Creek site. These are rather a menu of options that are intended to be further clarified with specific recommendations for the stream crossing during preconstruction reviews. "Yellow" crossings represent channels that have a moderate crossing risk where additional erosion control and construction methods specific to the site may be employed.

Table 1.3-1

Best Management Practices for Crossings in the "Yellow" and "Orange" Categories

Crossing Component	**Best Management Practices and (Source)** (These would be selected as needed by the FERC EI after a preconstruction evaluation with Agency Representatives.)
Streambed	• Dry ditch crossings (5) • Backfill with native material (3,4) • Backfill to match existing streambed gradation, composition as much as possible (4) Profile restored to existing profile and grade (4) • Stratified backfill for fish-bearing streams (1) • Structural fill placement (2)
Streambanks	• Typical erosion and sediment control Best Management Practices including erosion control blankets, silt fence, etc. • Narrowed construction disturbance (75 feet) corridor where feasible (2,3,4) • Narrowed permanent management corridor (2,3,4) • Revegetation with native plant materials (3, 4,6) • Bank graded/terraced to 3:1 (2,3) • Geotextile reinforced slope (5) • Fiber rolls (3) • Stream barbs/flow deflectors (5) • Toe rock placement (3) • Riprap placement (3) • Biotechnical "vegetation" riprap (3) • Tree revetments (3)
Riparian Vegetation	• Revegetation with native trees to within 15 feet of the pipeline parallel to the alignment (1, 3, 5, 6) • Revegetation with native woody riparian shrubs and trees (3) • Widened riparian corridor (Federal lands (3, 6) • Use of fast growing native tree species to accelerate shading (3)
Aquatic Habitat	• Stratified backfill for fish-bearing streams (1,2,4, 6) • Placement of large wood where appropriate (2, 4, 6)
BMP Source	1. FERC Guidelines 2. FEIS, JPA, Appendix C, Project Description 3. JPA Appendix 1B, Erosion Control and Revegetation Plan 4. JPA Appendix F, Affected Waters, Section 2.1.8.3 5. JPA Appendices 2C, 2D 6. JPA Appendix H, Compensatory Mitigation Plan Agency Representatives of the BLM and Forest Service may require additional measures necessary to meet Agency Standards under the terms of the ROW Grant.

At the crossing addressed in this report, the BLM has reviewed the crossing conditions, the general suite of BMPs (Yellow) and incorporated local knowledge and Agency objectives as appropriate. These are expressed as "Site Specific BMPs" in the following crossing prescriptions. This site-specific prescription is intended to focus the general recommendations that would apply to this site.

Attachments A, B and C provide additional information in support of the prescriptions in this report. Attachment A describes construction measures developed by GeoEngineers and Pacific Connector to be used in high sensitivity hyporheic streams. Attachment B describes FERC wetland crossing procedures to be used in wetland crossings. Attachment C provides background information on the use of hydraulic excavators for soil decompaction.

Section 2. Steinnon Creek Crossing, MP 20.25

2.1 Site Description

Steinnon Creek is located in the North Fork Coquille River fifth-field watershed within the Coquille Subbasin of the South Coast Basin. It is a perennial fish-bearing stream that is a tributary to Evans Creek, which is a tributary to the North Fork Coquille River. The PCGP crossing at MP 20.25 crosses approximately 77 feet of Steinnon Creek upstream of a barrier to anadromous salmonids. The confining valley is a V-shaped with moderate slopes of approximately 20%. The stream banks are estimated to have a slope of 17%. The gentle relief of the valley topography provides limited shade to the wetted channel during the summer months.

This reach of Steinnon Creek has a perennial flow regime with an estimated base flow discharge of about 0.22 cfs (as measured by BLM hydrologists in July 2015). Based on water temperature data collected by the BLM during the summer of 2013 the 7-day moving average (7DMA) maximum stream temperature of Steinnon Creek ranges between 53.5°F and 56.9°F and the 7DMA mean stream temperature ranges between 51.9°F and 55.9°F.

Within the crossing corridor, Steinnon Creek is narrow and shallow, with a gentle gradient (5%); the average wetted width is 6 feet and the average thalweg depth is 0.57 feet during the summer months. The streambed substrate is marine basalt bedrock, covered in areas with basalt cobble and pockets of silt. The stream banks are composed of course sand. Large and small woody debris provide shade and trap substrate at the crossing site (Figure 2-1)

The overstory vegetation associated with this crossing is predominantly Douglas fir, Hemlock and Red Cedar with an average height ranging between 120 and 150 feet as estimated by BLM hydrologists during field investigations. The understory is dominated by herbaceous and woody riparian vegetation such as Sword Fern, Oregon Grape, Salmonberry and Salal (Figure 2-1). The canopy cover is very dense, with an estimated 95% coverage on the west side of the creek and 90% on the east side of the creek. The riparian vegetation is set back by approximately 10 feet on west side of the creek and zero feet on the east side of the creek.

Oregon Department of Fish and Wildlife (ODFW) fish passage barrier data reports two cascade/falls fish barriers downstream of the crossing site. According to ODEQ, Steinnon Creek is designated for Salmon and Trout spawning and migration. However, the Salmon and Steelhead spawning use period is designated downstream of the crossing site (ODEQ 2005).

Figure 2-1. Steinnon Creek (MP 20.25) at the: a) upstream boundary; and b) the downstream boundary of the pipeline corridor.

2.1.1 Geomorphic Description

Steinnon Creek flows south through an elevated catchment that drains a prominent landform locally named Blue Ridge. Steinnon Creek can be classified as Rosgen Type A, Type B, or Type C stream throughout its course. The pipeline crossing of Steinnon Creek is located at the northern end of the catchment near the headwaters of Steinnon Creek (Figure 2-2 Location) and can likely be classified as a Rosgen Type B stream.

Blue Ridge is an ancient marine terrace that now occupies its current position at 1,600 feet above sea-level due to tectonic uplift and a progressive lowering of sea-level (BLM 2001). As a result, the rocks that underlie Steinnon Creek stream crossing are also of marine origin. At the stream crossing, Steinnon Creek has eroded through the bedded sand, silt, and clay of Quaternary-aged marine terrace deposits and exposed the underlying massive pillow and brecciated submarine basalts of the Roseburg Formation in the streambed (DOGAMI 2009 & BLM 2001). Both lithologies produce minimal material available for streambed substrate. Basalt is fairly resistant to erosion in a massive form or as boulders, but once it has eroded down to gravel size particles it readily erodes into finer particles. As a result, little streambed substrate is produced. The marine terrace deposits consist of erodible fine grained deposits and produces little streambed substrate. As a result, streambed substrate is limited at the stream crossing.

Soils in the area are composed of mostly silty clay loam with areas of silty or sandy loam. The clay content of these soils puts these soils at the risk of compaction and stream bank erosion (BLM 2001) due to the non-cohesive nature of the fine-grained materials and the silty soils (BLM 2001). Soil depth varies greatly throughout the area. The updated Geologic Hazards evaluation prepared by GeoEngineers (PCGP 2015) indicates that the depth to bedrock is greater than 60 inches at the crossing but a recent (2015) BLM field investigation indicates that the soil depth is at the crossing is several feet less than the depth reported by GeoEngineers at this site.. The Geoengineers (2015) evaluation also indicated that there are no previously identified areas of landslide hazard and there is an insignificant potential for rapidly moving landslide hazard (RML) hazard at the stream crossing site.

2.1.2 Location

Figure 2-2 shows the location of the Steinnon Creek crossing.

2.2 Resource Concerns

High intensity rainfall events (at least 4 inches in 24 hours) occur in the Coast Range Province on a cycle of 5+ years (BLM 2010: 17). There is a 90% probability of bankfull conditions occurring in any given year (Castro 1997). The North Fork Coquille River watershed exhibits rapid rise and fall in streamflow in response to storm events. Little water is stored as either snow or ground water in upland areas (BLM 2002). Planning related to both construction and restoration action needs to anticipate a bank-full condition each winter during the construction and post-construction periods.

The primary BLM resource concerns at the Steinnon Creek (MP 20.25) crossing are:

1. Potential increased bank erosion and attendant excess fine sediment accumulation in the channel during peak flow events from construction impacts and crossing configuration during peak flow events,

2. Soil compaction and sediment mobilization that may result from stream-side construction during rainy periods in the summer.

3. Maintaining likely subsurface flows. It is probable that there is a functioning hyporheic zone associated with Steinnon Creek.

4. Whether the trenching operation may capture part of the surface flows. The local massive and brecciated basalt is highly fractured which may intercept surface flows if they are exposed by the trenching operation. Interception or disruption of surface flows would be problematic given the minimal flows in Steinnon Creek during the summer months.

5. Effective revegetation of disturbed soils. Soils derived from underlying volcanic deposits may lack sufficient organic material to adequately establish vegetation after disturbance.

6. Stream temperatures may increase slightly as a result of shade removal.

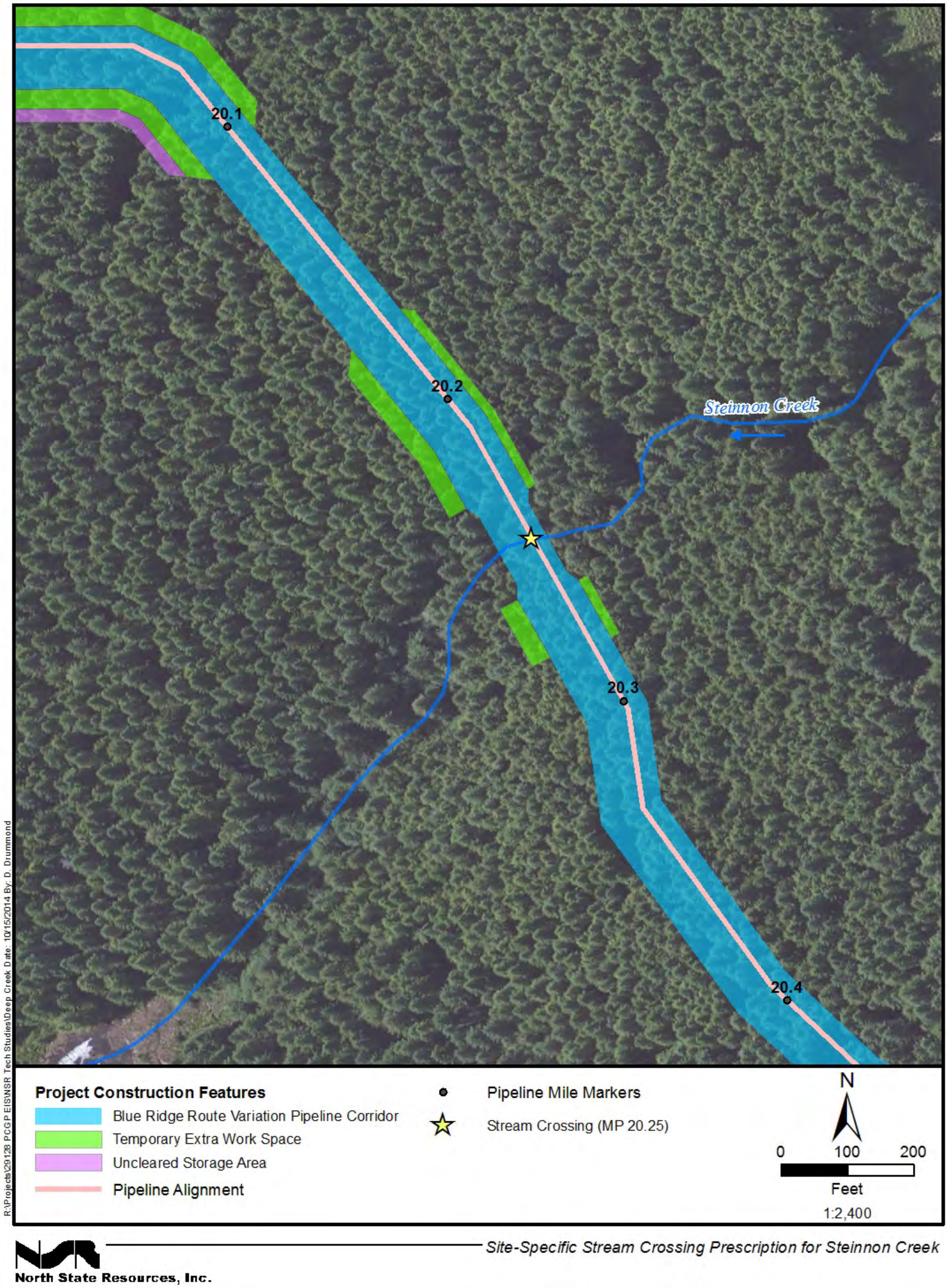

Figure 2-2. Steinnon Creek Stream Crossing Site

2.3 Desired Condition Upon Completion

The desired condition upon completion is that the crossing and associated Riparian Reserve provides the functions and values of processes and resources that occur prior to disturbance related to the PCGP project. The following prescriptive measures are intended to ensure compliance with the Coos Bay District RMP, including ACS objectives and management direction.

1. Soils have been decompacted with hydraulic equipment and are left mounded and discontinuous so that water cannot run straight downhill.

2. Effective ground cover has been reestablished prior to the onset of seasonal precipitation to prevent bank erosion and provide shade. Salal/Salmonberry is likely to quickly reoccupy site however erosion control fabric, annual rye or slash may be required for ground cover during the first winter after construction. Riparian vegetation typical to the site has been reestablished to its pre-crossing extent.

3. Large woody debris and slash has been used liberally throughout disturbed areas on all slopes to provide effective ground cover and intercept surface runoff. If waterbars have been used, location has been staked on the ground by an Agency representative prior to construction of the waterbar.

4. Small woody debris is placed across the channel to initially provide shade. As the wood decays and drops into the channel, the logs but will help raise the stream bed and promote some hyporheic exchange.

5. Stream channel banks, substrate composition, streambed gradient and morphology have been restored to their pre-crossing condition.

6. Water temperatures reflect the pre-crossing temperature regime.

7. Surface flows have not been intercepted by fractured geology.

8. Hyporheic/subsurface flows have not been altered by PCGP trench backfill.

2.4 Crossing Prescription

Steinnon Creek is a perennial stream that would be crossed on equipment bridges set during the instream construction window. The proposed crossing method is a dry open cut crossing, which may include flumes. Equipment bridges need to be removed before the onset of seasonal precipitation in the fall because Steinnon Creek is likely to experience bank-full conditions at least once during the rainy season. Based on the temperature gradients documented by the BLM, there is evidence of ground water and hyporheic flow. BMPs for maintaining flows are advised.

2.4.1 Wetland and Waterbody Crossing and GeoEngineers Crossing Risk Analysis

Table 2.4.1-1 is mainly adapted from information provided in the PCGP Addendum #2 to Response to May 22, 2015 BLM Data Request, specifically Table N-1b - Wetland and Waterbodies Impacted by the

PCGP Project and Table N-3b – Waterbodies Crossed by the Pacific Connector Pipeline (Appendix N, PCGP 2015). Sources of additional information provided in Table 2.4.1-1 are noted.

Based on GeoEngineers Risk Analysis Steinnon Creek was rated as "moderate" or "yellow" in the Risk Management Category for application of BMPs (Table 2.4.1-1) (PCGP 2015). Sites rated "yellow" include BMPs for sensitive bed, bank or riparian revegetation conditions to be selected by Environmental Inspector during construction (2015 PCGP).

Table 2.4.1-1

Wetland and Waterbody Crossing Plan, Steinnon Creek

MP	20.25
Waterbody Type	Perennial
Proposed Crossing Method	Dry Open Cut
Width of Creek (ft)	4.0 – 6.0
Channel Gradient (%)[1]	5
Streambed Material[1]	Marine basalt bedrock, covered in areas with basalt cobble and pockets of silt
Cowardin Classification	R4
Excavated Volume at Crossing (cubic yards)	10.67
Acres of Construction ROW in Wetland	0.01
Total Permanent Wetland Conversion (or fill) (acres)	0.00
Fish Use Designation[2]	Salmon and Trout Rearing and Migration
Designated Salmon and Steelhead Spawning Use[2]	October 15-May 15 (Below the crossing site)
Equipment Bridges	Yes
Overall Risk	Yellow

1 Collected in the field by BLM scientists
2 ODEQ Fish Use and Spawning Maps by Basin – Figures 300A and 300B (2005 ODEQ)

2.4.2 Site Specific BMPs

This section includes BMPs required by the BLM at this site to ensure that the desired condition of this segment of Steinnon Creek is met following PCGP clearing, construction and restoration activities.

Construction planning should anticipate at least one bank-full event during the winter, and several moderate to high intensity rainstorms during winter months. Some storm cycles may last several days and be followed in quick succession by another storm. It is critical to leave the site "buttoned up" with effective ground cover in place and earthwork completed prior to the onset of seasonal precipitation. Riparian Reserves at this location extend two tree lengths or 440 feet slope distance either side of the stream channel.

1. Multiple sediment barriers reinforced with erosion control fabric may be needed on the streambank and the slopes immediately above the channel in the first year of construction before effective ground cover and erosion control work are completed.

2. Retain logs and coarse woody debris removed during clearing and construction activities within the Riparian Reserve for placement on exposed soils to provide ground cover and prevent overland flow from occurring. Redistributing woody debris generated from the ROW clearing operation would be highly successful in preventing raindrop impact and rill erosion. Large woody debris and coarse woody slash be liberally applied at to all disturbed areas above the high water mark as defined on the ground by the BLM.

3. Aggressive erosion control seeding to establish 100% effective ground cover needs to be in place on the slope prior to the beginning of seasonal precipitation. Although salal and salmonberry is likely to quickly occupy the site, grass seed and mulch combined with coarse woody debris is the preferred erosion control method for immediate surface cover. Heavy application of grass seed, fertilizer and mulch has proven to be highly successful in preventing rain generated erosion in this area. Table 2.4.1-2 shows preferred species for the Coos Bay District BLM. For immediate ground cover, erosion control blankets may be used. The use of wood chips at this site for ground cover is not recommended because wood chips may inhibit success of erosion control seeding.

Table 2.4.1-2

Seed Mixture 1a – Erosion Control – Upland Right-of-Way Areas for BLM Coos Bay District Lands in Coos County

Common name	Scientific name	Pounds/acre
Californian brome	*Bromus carinatus*	8
Blue Wildrye	*Elymus glaucus*	12
Regreen or Quickguard a/		20
Total PLS lb./acre		40

a/ The use of native seed mix is preferred; however, there may be instances in highly erosive soils on steep slopes, where mixing sterile perennials such as sterile wheatgrass species or non-persistent annual grasses like Annual Rye could be appropriate. In these areas the Pacific Connector will include Regreen, Quickguard or annual ryegrass in the seeding mixture at 20 lbs/acre for erosion control, if approved, or at a rate specified by the BLM.

4. Place small wood across the channel, above the ordinary high water mark to provide shade, maintain the stream gradient, and promote some hyporheic exchange.

5. Replant the area outside the operational ROW corridor with conifers using a 50% Douglas-fir, 25% hemlock and 25% red cedar mix. Conifer seedlings need to be protected from browsing deer and elk with biodegradable vexar tubing approved by the BLM until the seedlings are established. Minor amount of dogwood and elderberry may be planted within this zone as well. See Table 2.4.1-3 for planting specifications.

Table 2.4.1-3 Native Shrub and Tree Plantings for Restoring Wetland and Riparian Areas, Steinnon Creek Crossing, Coos Bay District, BLM			
Common Name	**Scientific Name**	**Planting size**	**Plant Spacing**
Shrubs			
Red elderberry	*Sambucus racemosa*	1 gallon	Variable, clumped as minor component of site inside the permanent ROW. Estimate 20 planting within Riparian Reserve.
Trees			
Pacific Dogwood	*Cornus Nuttallii*	2 gallon	Variable, clumped as minor component of site outside of permanent R/W. Estimate 10 plantings within Riparian Reserve.
Western red cedar a/	*Thuja plicata*	2 gallon or bare root with vexar tubing	15' spacing outside of permanent R/W
Western hemlock a/	*Tsuga heterophylla*	1 gallon with vexar tubing	15' spacing outside of permanent R/W.
Douglas' fir a/	*Pseudotsuga menziesii*	1 gallon or bare root with vexar tubing	15' spacing outside of permanent R/W
a/ Conifer seedling mix on the Coos Bay District BLM is 50% Douglas-fir, 25% western hemlock and 25% western red cedar.			

6. Limit stream-side operations during periods of wet weather. Stream-side operations during wet weather have been shown to significantly increase soil compaction and sediment mobilization.

7. Silt barriers may be needed as a temporary measure. If necessary, install appropriate sediment barriers adjacent to the stream channel. This may include silt fences backed with hay bales, fiber rolls and other mechanical methods of intercepting sediment. If upland soils are decompacted and coarse wood and grass seed are used to maximum advantage, silt barriers would likely not be needed once construction is completed.

2.4.3 Crossing Plan

Figure 2-3 provides a plan-view description of the completed crossing.

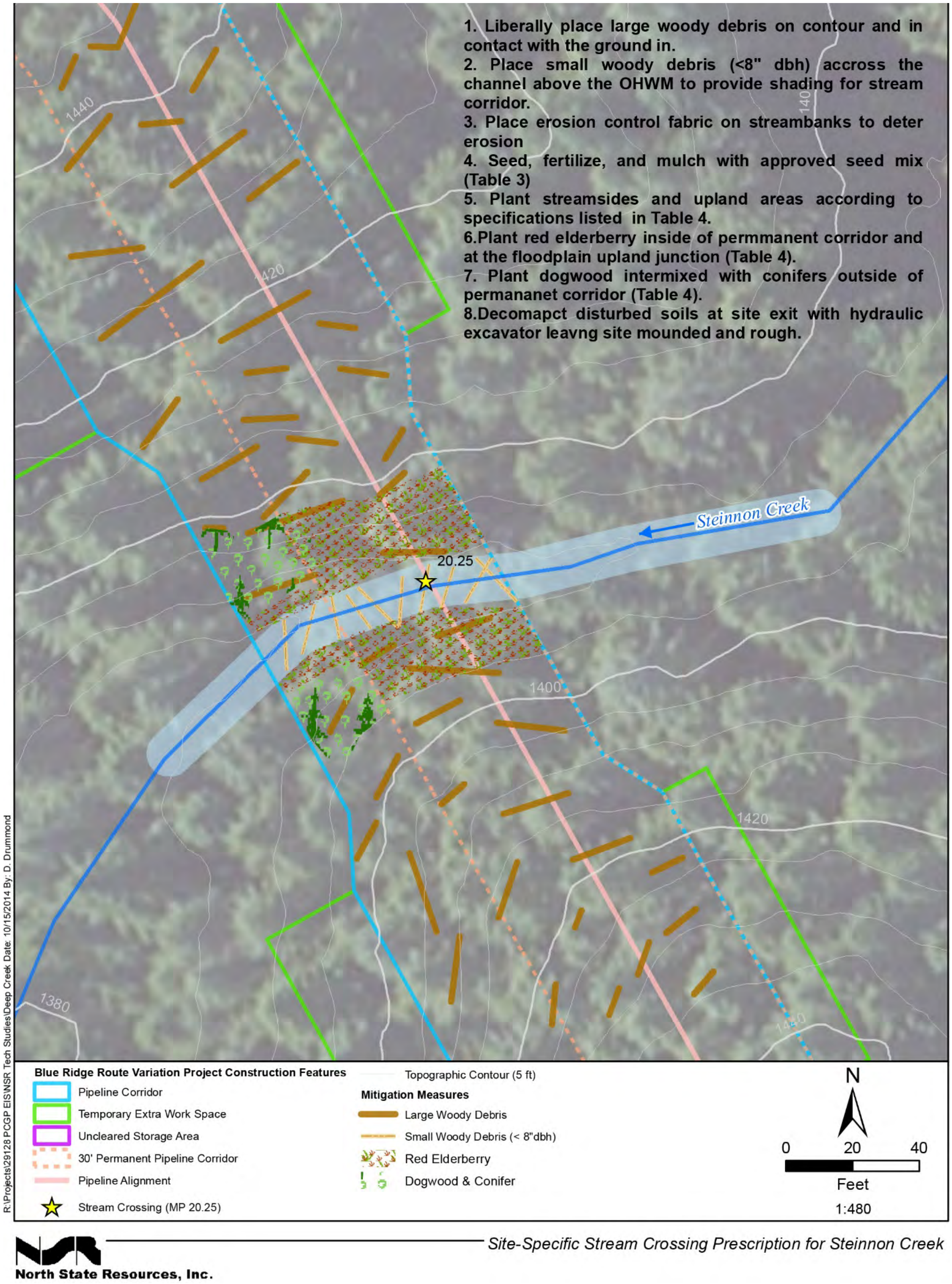

Figure 2-3. Steinnon Creek Stream Crossing Plan

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ATTACHMENT A

Construction Measures in High Sensitivity Hyporheic Streams

Attachment A

Construction Measures in High Sensitivity Hyporheic Streams[1]

Details of pipeline construction have been described in the Pacific Connector Certificate Application (2013). The side-slopes of trench excavations are maintained as close to vertical as the earth materials and construction requirements allow. A pipeline trench approximately 6 feet top width, 2 to 4 feet bottom width, and 6 to 9 feet deep will be the typical excavation dimensions. The US Department of Transportation (DOT) requires at least 2.5 feet of cover over pipelines, and Williams has committed to at least 3 feet of soil cover away from streams[1] and up to 5 feet of cover in streambeds. Pipelines are bent to go under stream crossings, and the location of the bend may be adjusted away from the stream bank slightly to account for channel dynamics, requiring a locally deeper excavation into and out of the stream channel. If the materials at the base of the excavation are irregular or very coarse grained, overexcavation of approximately 1 foot may be required to ensure that the pipeline can be placed on a smooth bed to reduce any potential for damage. Trench backfill consists of the following (from bottom to top):

- 1 foot of backfill using ¾-inch and smaller material, screened from native backfill, to provide a uniform bed for the pipe (termed "shading").
- 3-foot-diameter pipe. Shading material also is used between the pipe and adjacent trench walls.
- 1 foot of shading overlying the pipe.
- 1 foot or more native backfill material to come within 1 foot of desired finished grade.
- 1 foot of streambed materials in the active channel bottoms or topsoil away from the active channel bottom (i.e., on banks and floodplains).

The backfill may be placed and compacted on steep banks to form structural fill, as described in the Erosion Control and Revegetation Plan (ECRP; Appendix 1B of the JPA). Salient aspects of pipeline construction related to potential changes in hyporheic exchange include the following:

- From the Federal Energy Regulatory Commission (FERC) Wetland and Waterbody Guidance on site restoration):
  - "Use clean gravel or native cobbles for the upper 1 foot of trench backfill in all waterbodies that contain coldwater fisheries." [n.b., see minor modification below]
  - "Return all waterbody banks to preconstruction contours or to a stable angle of repose as approved by the EI.
  - Application of riprap for bank stabilization must comply with COE, or its delegated agency, permit terms and conditions. Unless otherwise specified by state permit, limit the use of riprap to areas where flow conditions preclude effective vegetative stabilization techniques such as seeding and erosion control fabric.

[1] GeoEngineers Stream Crossing Hyporheic Analysis, p 8. This section is reproduced verbatim from the GeoEngineers' analysis except as noted.

- "Revegetate disturbed riparian areas with conservation grasses and legumes or native plant species, preferably woody species."

- "Install a permanent slope breaker across the construction ROW at the base of slopes greater than 5 percent that are less than 50 feet from the waterbody, or as needed to prevent sediment transport into the waterbody. In addition, install sediment barriers as outlined in the Plan. In some areas, with the approval of the EI, an earthen berm may be suitable as a sediment barrier adjacent to the waterbody." **(Note on the use of waterbars on BLM lands. Waterbars concentrate water and may cause substantial soil erosion. Waterbars are to be installed on BLM and NFS lands only when agreed and marked on the ground by agency representatives)**

- From the Plan of Development Wetland and Waterbody Crossing Plan (October, 2010, Appendix 1 *Variances to FERC's Procedures Approved on Federally-Managed Lands*), according to Section V.C.1. of FERC's Procedures, "…clean gravel or native cobbles for the upper 1 foot of trench backfill."

- From the JPA Appendix C (General Project Description Section 1.5.2 Survey and Staking): "PCGP will document existing detailed site biological conditions in detail concurrent with the timber removal phase (i.e., in the construction season prior to pipeline installation) to aid in restoring the site to pre-construction conditions."

- From the JPA Section 3: "Native material that is removed from the pipeline trench during excavation will be used to backfill once the pipe is in place. Fill material will be a soil or gravel material that is screened to exclude rock greater than a predetermined size. The pervious fill material will be clean, naturally occurring granular bank run or plant processed soil material obtained from commercial sources."

From the ECRP: 3.3.9 Lowering Pipe and Backfilling

- The pipe assembly will be lowered into the trench by side-boom tractors and backhoes. The trench will be backfilled using a backfilling machine or bladed equipment. No foreign substance, including skids, welding rods, containers, brush, trees or refuse of any kind, will be permitted in the backfill.

- Trench breakers will be installed in the trench on slopes prior to backfilling to prevent water from flowing along the pipeline and eroding trench backfill materials (see Section 4.2.1). Trench breakers shall be generally spaced according to the spacing in Table 4.2-1, unless directed otherwise by the EI or authorized company representative. Trench breakers will also be installed at the base of slopes adjacent to wetlands and waterbodies and where needed to avoid draining of wetlands or affecting the original wetland or waterbody hydrology. Pacific Connector will utilize sandbags (foam trench breakers may be used if approved by the authorized company representative) for trench breaker construction (see Section 4.2.1 for additional trench breaker details). Topsoil will not be used to fill the bags. Where necessary, Pacific Connector will use trench plugs constructed of bentonite at appropriate locations to prevent flow from wetlands or streams into the trench and to preserve the original wetland and/or waterbody hydrology. The contractor will backfill and stabilize areas as soon as possible according to FERC's Upland Plan

(Section V. A. 1.) which specifies that final grading topsoil replacement and installation of permanent erosion control structures will be completed within 20 days after backfilling the trench (10 days in residential areas). However, if seasonal or other weather causes delays, temporary erosion control measures (temporary slope breakers and sediment barriers) will be maintained until conditions allow completion of cleanup.

Specifically, the BMPs which are of particular importance to reduce the potential impacts to the hyporheic zone include the following:

- Native material that is removed from the pipeline trench during excavation across stream channels will be used to backfill once the pipe is in place in order to minimize potential changes to preconstruction permeability.

- Trench plugs will be installed at the base of slopes adjacent to wetlands and waterbodies and where needed to avoid draining of wetlands or affecting the original wetland or waterbody hydrology.

While the potential impact of pipeline construction on hyporheic exchange is considered to be low at all stream crossings considering the proposed construction methods, PCGP proposes these additional measures to further reduce the potential for even localized impacts to water quality from hyporheic exchange at the stream crossings identified as having high hyporheic sensitivity (Appendix A, Table A-1).

- Document streambed stratigraphy prior to construction if possible, or if not possible, during construction to aid in site restoration. Such documentation will be conducted by staff trained in recognizing and observing river channel processes. If done during construction, this may be performed by the EI after receiving suitable training.

- Segregate active streambed gravels and cobbles from underlying streambed materials (including fractured bedrock) to their natural depth and replace gravels/cobbles to this natural pre-construction depth.

- Below active stream gravels, replace native material in a manner to match upstream and downstream stratigraphy and permeability to the maximum extent practicable.

ATTACHMENT B

Wetland Crossing Procedures

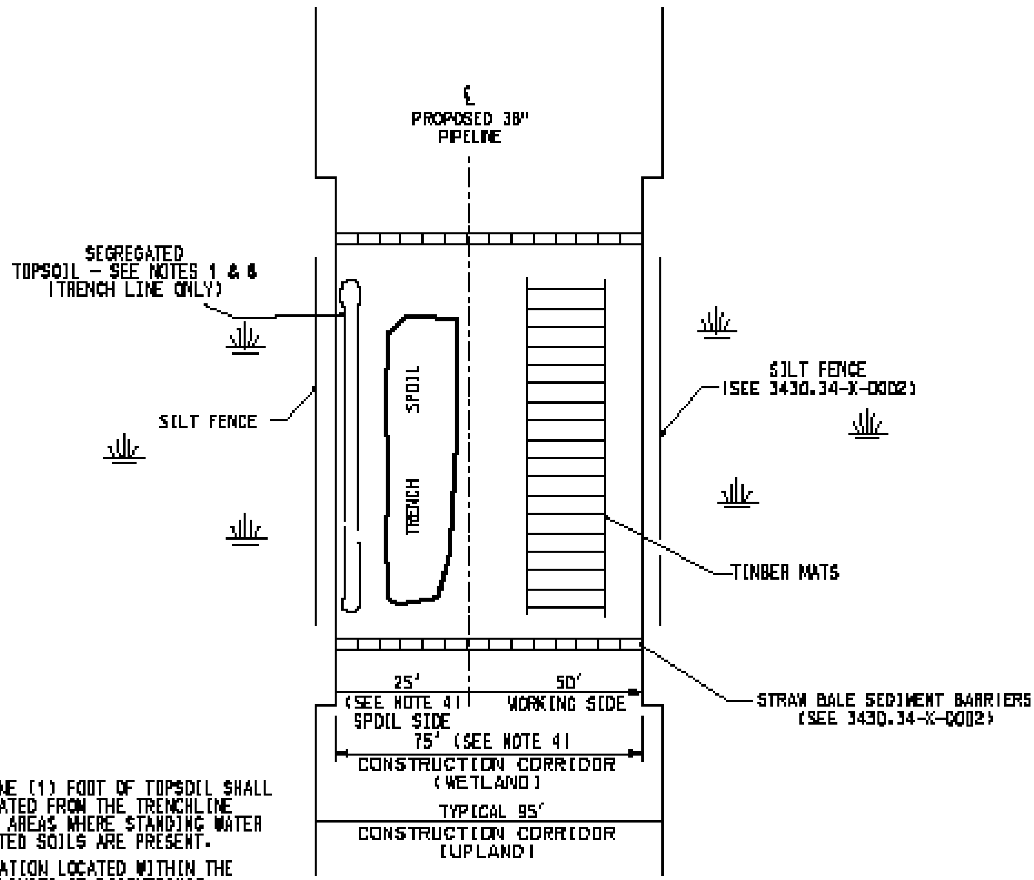
Attachment B

Wetland Crossing Procedures

All wetlands will be crossed in accordance with FERC's Procedures (see Attachment B to the ECRP – Appendix I to the POD). Drawing 3430.34-X-0005 in Attachment C to the ECRP shows the typical wetland crossing methods that will be utilized during construction. Wetlands crossed by or in close proximity to the PCGP Project are shown on the Environmental Alignment Sheets (Appendix DD to the POD). Table 3-1 provides a list of the wetlands that are crossed on federally-managed lands. At most wetland crossings the construction ROW has been limited to 75 feet in width from the normal 95-foot width of the ROW to limit disturbance to wetlands, consistent with FERC's Procedures (see Section VI.A.3.). In most cases, except where topographical or other constraints occur, TEWAs have been located at least 50 feet away from waterbody and wetland boundaries as required by FERC's (see Sections VI. A. 3. and VI. B. 1. a). Where "neck-downs" or setbacks from waterbodies or wetlands could not be achieved based on site-specific constraints, variances have been requested from FERC's Procedures (see Attachment 1 and/or Appendix I to the FEIS).

Where clearing is required, Pacific Connector will cut, mow, or shear woody vegetation so that the roots are left intact, consistent with Section VI. B. 2.f. of FERC's Procedures. This will facilitate the sprouting of tree and shrub species so that the recovery time following construction is minimized. The roots will also help hold the soils so that erosion is minimized. To further promote reestablishment of native wetland species, 12 inches of topsoil will be salvaged in all unsaturated wetlands over the trenchline. The salvaged topsoil will be stockpiled to prevent mixing with subsoils or spoil materials and returned to the top of the trench after construction. Topsoil salvaging will promote reestablishment of wetland species by preserving the vegetative propagules (seeds, roots, tubers, rhizomes, bulbs) present in the soil. Propagules potentially promote reestablishment of native wetland vegetation by germinating or sprouting from replaced topsoil.

WETLAND CROSSING DETAIL



NOTES:

1. THE TOP ONE (1) FOOT OF TOPSOIL SHALL BE SEGREGATED FROM THE TRENCHLINE EXCEPT IN AREAS WHERE STANDING WATER OR SATURATED SOILS ARE PRESENT.
2. THE VEGETATION LOCATED WITHIN THE PROPOSED LIMITS OF DISTURBANCE SHALL BE CUT OFF AT GROUND LEVEL LEAVING THE EXISTING ROOT SYSTEMS IN PLACE, EXCEPT AS SPECIFIED IN NOTE 3.
3. PULLING OF TREE STUMPS AND GRADING ACTIVITIES SHALL BE LIMITED TO THE AREA DIRECTLY OVER THE TRENCHLINE UNLESS SAFETY CONDITIONS REQUIRE THE REMOVAL OF TREE STUMPS FROM UNDER THE WORKING SIDE OF THE WORK CORRIDOR.
4. CONSTRUCTION CORRIDOR THROUGH WETLANDS WILL BE 75 FEET WIDE UNLESS A VARIANCE IS GRANTED. CONFIGURATION OF RIGHT-OF-WAY MAY VARY.

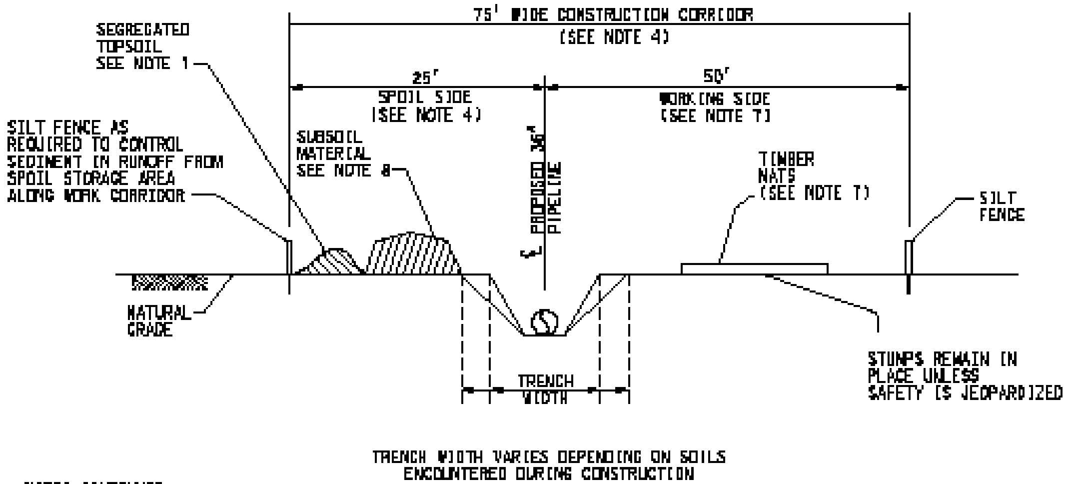
PLAN VIEW

PACIFIC CONNECTOR GAS PIPELINE PROJECT
PACIFIC CONNECTOR GAS PIPELINE, LP
CROSSING DETAIL FOR WETLANDS

Pacific Connector Gas Pipeline

DRAWING NUMBER: 3430.34-X-0005
SCALE: NONE
SHEET 1 OF 2

North State Resources, Inc.
August 2015



NOTES CONTINUED:

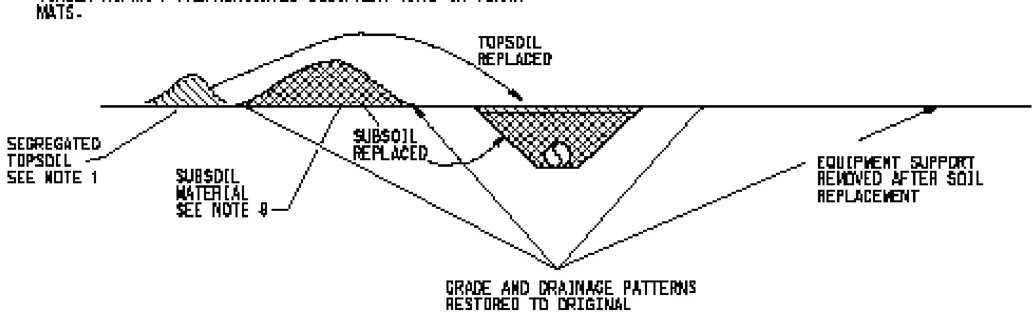
CROSS SECTION

5. SILT FENCE OR STRAW BALES WILL BE USED WHERE APPROPRIATE TO PREVENT SILTATION INTO WATER BODIES OR WETLANDS.

6. SILT FENCES OR STRAW BALES WILL ALSO BE USED TO PREVENT STOCKPILED SOIL OR SPOIL FROM LEAVING THE CONSTRUCTION RIGHT-OF-WAY OR WORKSPACES.

7. TIMBER MATS MAY BE USED OVER SPOIL STORAGE WHERE STANDING WATER OR SATURATED SOILS ARE PRESENT.

8. IF STANDING WATER OR SATURATED SOILS ARE PRESENT, OR IF CONSTRUCTION EQUIPMENT CAUSES RUTS OR MIXING OF TOPSOIL AND SUBSOIL IN WETLANDS, USE LOW-GROUND WEIGHT EQUIPMENT, OR OPERATE NORMAL EQUIPMENT ON TIMBER RIPRAP, PREFABRICATED EQUIPMENT MATS OR TERRA MATS.



WETLAND RESTORATION

NO.	DATE	REVISION DESCRIPTION	BY	CHK/APPR.

PACIFIC CONNECTOR GAS OPERATOR, LLC.
PACIFIC CONNECTOR GAS PIPELINE PROJECT
CROSSING DETAIL FOR WETLANDS

Pacific Connector GAS PIPELINE

DRAWN	APPROVED	DRAWING NUMBER: 3430.34-X-0005	SHEET 2 OF 2
CHECKED	SCALE NONE		

ATTACHMENT C

Use of Hydraulic Excavators for Soil Decompaction

Attachment C

Use of Hydraulic Excavators for Soil Decompaction

Summary

For several years the Umpqua National Forest, Diamond Lake Ranger District (DLRD) in Region 6 has been developing methods and implements to improve soil productivity in areas degraded by previous activity. Previous activities include timber harvest, undeveloped recreation, and temporary or unwanted roads. The objective is usually watershed restoration. These new methods were developed to cut the cost of restoration activities and assure a satisfactory result. Key to the success of these operations is the return of soil tilth to compacted soil, which was caused by equipment and road use. The failure to adequately treat compaction and retain surface organic material during site restoration will reduce potential soil productivity and overall recovery. The Umpqua National Forest believes that the developed methods and implements fully meet the U.S. Department of Agriculture (USDA) Forest Service Chief's objectives for land stewardship, the Aquatic Conservation Strategy (Northwest Forest Plan), and the President's Healthy Forest Initiative.

Background

Ground-based harvest systems can cause the greatest area of detrimental compaction during forest management activities. After a ground-based harvest ends, skid trails and landings may be visible for years or decades. On the Umpqua National Forest, ground-based harvests and related site preparation, done before 1990, created more compaction due to loose enforcement of requirements for designated skid trails, landings, and dozer slash piling operations. Current harvest management now requires designated skid trails and the use of low ground-pressure equipment when piling to reduce the total amount of compaction occurring during harvest. The USDA Forest Service Manual on forest soils, directs that activities will create less than 20 percent increase in detrimental soil conditions, (FSM 2521. 1-1 a, R-6 Supplement 2500-96-2). Even if these measures are met, the opportunity to exceed the 20 percent threshold remains if the next entry does not use the same skid trails. This effect is compounded in second entry harvest areas where dozer slash piling took place in the first entry.

Subsoiling skid trails and temporary roads after each entry will reduce the opportunity for cumulative detrimental soil conditions. Proven to increase the survival and growth of seedlings, subsoiling begins the process of restoring areas of previous compaction, when followed by vegetation establishment. However, since there is a high economic cost associated to subsoiling, it is often considered a last resort after multiple planting failures. Prior to restoration efforts, compaction can cause localized surface erosion, which may remove the topsoil and hinder the soil's ability to support vegetation, either planted or desired native vegetation. Organic material lost during the original slash treatments (30+ years old) and subsequent erosion of topsoil may have eliminated enough nutrient value to delay vegetative recovery.

The common treatment for compaction is to subsoil with an agricultural subsoiling implement or dozer-mounted ripper system. Though there are problems with dozer subsoiling the cost of treatment is often the lowest available. The problems with dozer subsoiling are spotty treatment coverage from maneuvering around obstacles and difficulty in maintaining effective ground cover. Thick brush, stumps, boulders, and standing trees can inhibit the dozer from reaching all compaction in the treatment area. Avoiding live trees and their root systems can also reduce the total treatment area, leaving those trees to survive under isolated poor tilth conditions. The greatest long-term drawback of subsoiling with a dozer-drawn implement is the inability to return organic material (i.e., grass sod and woody material of varying sizes) to the treated surface. Dozer subsoiling can expose the soil by creating bare areas when organic material accumulates under the drawn implement. Additionally, inattention during operations can cause boulders to surface, resulting in a boulder field. Loss of organic material on the surface of exposed soil can also have a detrimental effect, especially on those soils already low in nutrient and moisture-holding capacity. Adequate surface organic material creates a buffer from temperature and moisture fluctuations increasing plant vigor and growth.

Often associated with ground-based systems, grapple-piling operations provide a means of treating compaction before leaving the harvest unit. To date, the removal of logging residues from the site and treatment of compaction (subsoiling operations) has been accomplished separately in time, and sometimes by differing equipment. Multiple entries on the same acreage raise the overall cost of treating an acre of land. Recently an exception to multiple entries has begun. Excavators used for grapple piling are employed to decommission temporary roads and landings immediately following log haul.

Excavators are versatile when piling or subsoiling. Current application of excavator subsoiling has been limited to treating little more than temporary roads and landings. When the need to subsoil more than temporary roads and landings presents itself, the level of versatility and precision must be weighed against the lower cost of equipment and acreage production a dozer operation can provide. Depending upon the amount of acreage intended for treatment, a grapple piling operation would have to be "piggybacked" with a dozer subsoiling operation to be economical.

Excavators treat compaction by forcing the machine's grapple rake or tines into compacted soil. Though this loosens the soil, it may bury surface organic material reducing effective ground cover. Though organic material can be lost during subsoiling, the excavator can utilize available slash during piling for effective ground cover. Placing organic material on top of a subsoiled surface has been shown to maintain soil aggregate stability, which can allow for increased natural regeneration and maintain the vigor of planted seedlings (observations on subsoiled temporary roads indicate 6+ years of soil aggregate stability).

To remedy various detrimental soil conditions and improve the production of excavator subsoiling, two implements were invented on the Umpqua National Forest, DLRD.

1. Subsoiling Grapple Rake (SGR). This instrument was designed to forgo the lag time between activities that create compaction (such as temporary harvest roads, skid trails, mechanized fuels reduction, site preparation, and grazing). The SGR can be used to treat legacy compaction thought to be remedied by time and frost heave.

2. Subsoiling Excavator Bucket (SEB). This instrument was designed for road decommissioning and resource restoration resulting in improved water quality, fisheries enhancement, and return of hydrologic function within a given watershed.

Equipment Description and Uses

Subsoiling Grapple Rake (SGR)

The implement was created specifically for prescriptions that combine brush disposal/grapple piling, with the needs of subsoiling newly created or legacy compaction[1]. The use of the SGR in grapple-piling operations will treat compaction and utilize slash as effective ground cover for the subsoiled areas. This differs from present practices where slash is disposed of then subsoiling is introduced years later when legacy compaction is identified as a problem. The SGR may reduce costs of reforestation, while allowing the soil resource to maintain or restart its natural developmental. The integration of differing project work can reduce potential negative impacts of forest management by treating compaction directly after it is created.

Logical common applications for both fuel treatment and subsoiling:

1. Grapple piling for post-timber harvest fuel reduction or slash removal
2. Obliteration of skid trails, temporary roads, and landings
3. General subsoiling for soil productivity issues
4. Placement of organic material on subsoiled areas for effective groundcover

The SGR combines aspects of both fuel treatment and subsoiling and effectively eliminates future compaction issues at the close of harvest. These benefits are realized without compromising grapple-piling production rates. In addition there is also an increase in effectiveness of the subsoiling treatment. Dozer subsoiling avoids areas of rock and heavy vegetation. The SGR still avoids the rock, but it can also remove dense brush, and subsoil where needed and then place this material back, as groundcover. The SGR combines the best attributes of grapple piling and subsoiling. The SGR can reduce operational costs while increasing opportunities for soil restoration efforts. Figures 1 and 2 show photos and drawings of the implement in different modes/positions.

Legacy compaction is from ground-based harvest without designated haul and harvest routes, dozer pile slash treatment, undeveloped recreation, grazing, or abandoned roads.

Figure 1. Pictures show the SGR in positions or modes of use for each operation. (Pictures by D. Morrison)

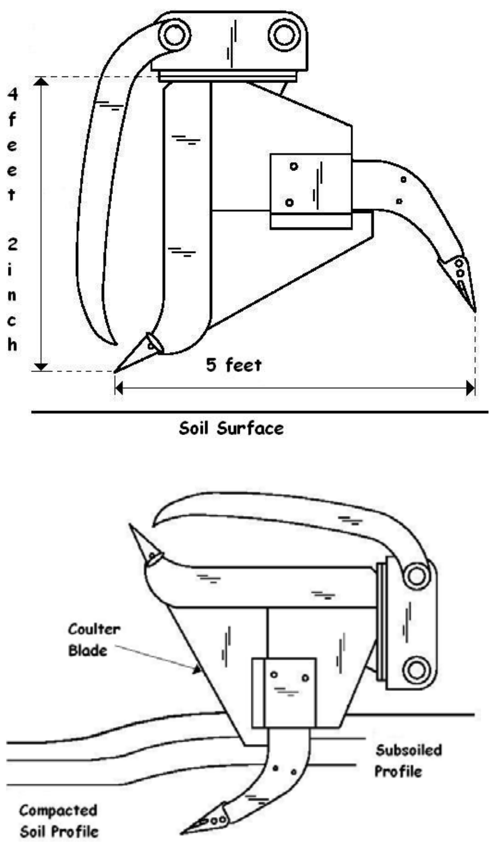


Figure 2. Drawings show the SGR in grapple mode (top) and subsoiling mode (bottom).

Using the SGR on a prescription for subsoiling and grapple piling (such as might be done with KV or BD[2] funds or a stewardship contract) on the DLRD showed an estimated savings of approximately $490 per acre (when compared to past contract costs for doing the work separately). Logging contractors who, under timber sale contract requirements, may be responsible for the disposal of logging slash and the removal of temporary roads and landings at the close of logging operation may benefit by using this equipment.

How the SGR Functions

The SGR implement creates a broken pattern for water to enter the soil and eliminates the continuous furrow associated with dozer subsoiling. This can prove beneficial in the decommissioning of skid trails and other compaction on slopes up to 30 percent, or conditions with a heavy clay horizon buried in the soil. The broken pattern is a beneficial result of the excavator being unable to treat the soil while traveling. Figure 3 shows a conceptualized drawing of dozer and excavator subsoiling.

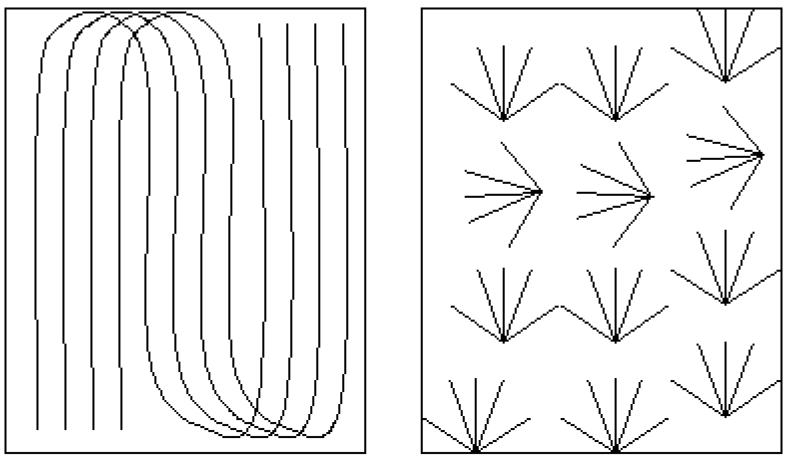


Figure 3. Conceptual drawings of subsoiling patterns. The left drawing shows the continuous furrow pattern associated with dozer subsoiling. The right drawing shows the broken pattern associated with the SGR.

During regular grapple pile operations the SGR allows for the restoration of compacted areas previously too small for separate service contracts (i.e., landings, skid roads, loader, and temporary roads).

As a fully operational grapple rake and/or subsoiling implement; the SGR utilizes the thumb (a feature available on most excavator models) and rake to grasp slash and build piles for burning at a later time. Depending upon the amount of material available, a portion of this debris is either left as groundcover or piled. Once the area retains the prescribed effective groundcover, the SGR is repositioned to subsoil. This change in position can be seen in figure 1, which shows the two operational modes and a picture of each action. The SGR has incorporated into its design, a coulter blade with each subsoiling shank to deal with

Funds collected from timber sales for Knutson-Vandenburg (KV) – reforestation and rehabilitation or Brush Disposal (BD) – fuel treatments.

surface or subsurface organic obstructions, such as roots. These coulters have the same application as coulter wheels (standard on many agricultural implements), which cut roots and surface material thus parting the soil for the implements passage. This feature is seen in figure 2 (bottom drawing). When a sizeable obstruction, such as a large root or tree branch, is encountered during subsoiling the SGR obtains optimal function of the coulter blades by tilting towards the excavator. It is with this tilting action that the coulter blade acts as a guillotine, severing the object and allowing the subsoiling pass to continue.

In the case of a first entry harvest, subsoiling will not be needed outside of skid trails or temporary harvest roads. In a second entry situation, subsoiling may be needed outside of skid trails and temporary roads to treat legacy compaction. After the area is subsoiled, oversized organic material (slash, logs, or brush) if moved, are returned to their former locations. Subsoiling with this implement is done to a maximum depth of 30 inches or to the operational depth of whatever subsoiling shanks and wing tips are used. The act of subsoiling, regardless of the method, creates a tortuous path for the infiltration of water vertically through the soil profile.

Subsoiling Excavator Bucket (SEB)

The success of the SGR provided the incentive for the DLRD to undertake the development of another implement. This concept was supported by Dexter Meadows (Program Leader, Recreation and Watershed/Soil/Air at the San Dimas Technology and Development Center) to build the SEB prototype. The SEB was specifically created for total road obliteration prescriptions and can be seen in figure 4. The prescription where this implement is most important will be in the obliteration of midslope roads that can impact fish-bearing streams. The economic and production rate benefits of this implement are similar to those of the SGR.

Figure 4. Side view of the prototype SEB.

These are the tasks that can be completed by the SEB:

1. Culvert removal
2. Water-bar installation
3. Subsoiling of the roadbed

4. Outsloping of the road prism or complete obliteration of the road

5. Removing fill from small and large draws

6. Returning fillslope material to near original slope position

Currently, road obliteration projects can be accomplished either by an excavator alone or in concert with a large dozer (e.g., Caterpillar D8, with rear ripper). During an outslope recontouring of the road prism with a dozer, it rips the road, then spreads fill material from the road edge to the ditchline. This process can cause a return of compaction in the ripped road prism when the dozer spreads the fill material, since it is unlikely to rip and spread in a concurrent operation. On roads requiring culvert removal the equipment will travel across the newly outsloped prism, causing new compaction.

In small operations, high equipment costs and equipment logistics can reduce the final project to culvert removal and slope recontouring over the existing compacted roadbed and ditchline. This project would still leave a condition, which may cause slope failure at some future time.

Another treatment example may be simply subsoil a road for the objective of reducing watershed road densities. This project is usually accomplished with a dozer pulling an agricultural subsoiling implement or dozer-mounted ripper system. This method will improve water infiltration, but the placement of organic material, if applied to the treated area at all, is left to hand crews spreading straw mulch. If the site was deficient in organic matter the subsoil treatment area would be left exposed to the elements, which provides an opportunity for further degradation of surface aggregates with rain splash and soil crusting that could lead to erosion. (Luce1997)[3]. When using a SEB, large bales of hay can be positioned along the road prior to subsoiling. The SEB can be used to spread the mulch as it exits the road.

How the SEB Functions

The SEB combines two dissimilar management activities, excavation and subsoiling. The SEB-equipped excavator can either replace the need for a dozer on small jobs or enhance the overall result of road decommissioning on large projects. The SEB-equipped excavator will be the last machine out of the project area, subsoiling the footprint of all equipment to a depth of 24 to 30 inches. This added effort could enhance the growth and vigor of vegetation in the newly created seedbed.

The SEB is an excavator bucket, modified by adding subsoiler shanks with coulter blades to enter the soil and loosen road fill (figures 5 and 6). The shanks extend downward below the bucket and curve forward toward the bottom of the bucket, allowing a single implement to be used for both excavating and subsoiling. Rotating the implement while attached to an excavator boom can allow the use of either mode.

[3] Luce, C.H. 1997. Effectiveness of road ripping in restoring infiltration capacity of forest roads. Restoration Ecology 5(3) 265-270.

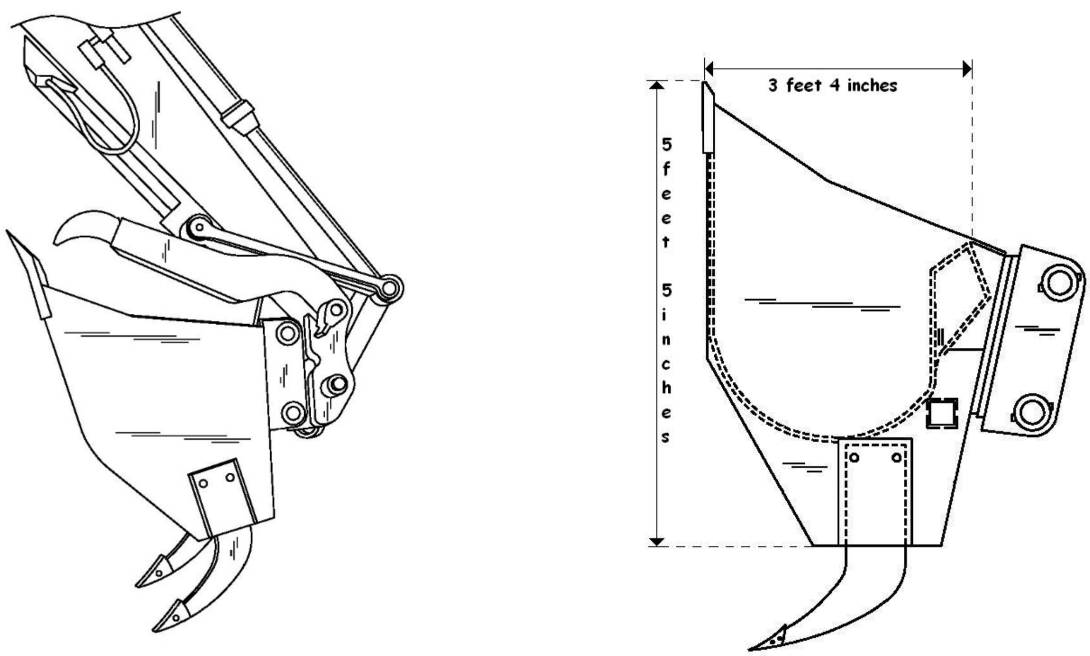


Figure 5. Left is a view of the mounted SEB. Right is a side view showing the bucket and dimensions of the implement.

The bucket mode is obtained through the normal range of operation of the excavator. The subsoiling mode is obtained by rotating the bucket toward the closed position and bringing the subsoiling shanks into a vertical position for movement through the soil, typically beneath the compacted layer and parallel to the soil surface. In coarse-textured sandy soils, the bucket can attain full range of motion. This range of motion allows the implement to do some subsoiling during excavation, loosening the next bucket scoop. This benefit is diminished in heavy, clayey soils and rock substrate, to the point where a single mode is suggested. Subsoiling results with this implement are similar to that described for the SGR.

Road obliteration using the SEB

Subsoiling with the SEB

Figure 6. Operational views of the SEB.

Similarities between the SGR and SEB

No new mechanized parts were added to common grapple rake or excavator bucket designs. Alterations to both implements were the additions of sockets and coulter blades for the two subsoiling shanks. Standard components were used wherever possible to allow local procurement of worn parts. These implements are intended for operation on any excavator, not less than 44,000 and up to 50,000 pounds gross vehicle weight rating (GVWR). This allows for adequate hydraulic power and excavator stability necessary for full functional capability. The shanks used for subsoiling are standard John Deere part number A24206. The subsoiling shanks can be standard commercial parts or similar fabricated steel shanks, typically having a curvilinear profile. It is this curvilinear shank, which acts like a wedge to lift the compacted soil profile. The momentum of lift energy moves, in front of, and across the wings; sending fractures through the plate-like structure of the compacted soil profile. The estimated amount of fracture, leading and lateral, can be as much as 7 to 12 inches wide. With experience, an operator can easily adjust the depth of de-compaction by visual control of the shank penetration into the soil.

These observations were made in field trials and practical application using John Deere 5- to 7-inch wing tips. The current designs for each tool incorporate adapter plates for standard John Deere and Caterpillar excavator connection hardware. The tools can be readily disconnected and reconnected by quick-disconnect attachments as shown in figure 7. This quick disconnect feature facilitates rapid change of excavator tools (as needed) at the worksite.

Figure 7. Close-up of coupling assembly and uncoupling from the SGR.

The DLRD has associated the need for overlapping passes with conditions of strongly cemented to indurated soil. This overlapping method is also indicated when working in very bouldery conditions and road decommissioning. In the deep pumice soils of DLRD, custom-made mild steel wing tips up to 10 inches have proven reliable for projecting lateral and forward fractures while subsoiling.

Subsoiling has been proven to increase vegetation survival and growth in areas previously compacted. It is the return of organic material, which stabilizes the subsoiling treatments. Returning organic material to soil treated for compaction has been shown to enhance vegetative response4. The SGR and the SEB are working well to restore soil tilth and provide optimum seedbeds for revegetation.

Conclusions

The SGR and SEB are not intended to replace traditional dozer subsoiling defined earlier. These implements should be considered an alternative or additional method to use when developing a land restoration prescription. Now fully developed, these two implements are part of a planned suite of three subsoiling implements. The third (being developed and tested) will apply to another area of forest management. The inherent economic benefit of the SGR and SEB to the USDA Forest Service will be a reduction in contract costs. These costs are reduced by eliminating multiple entries with differing equipment and objectives, having one equipment transportation cost, reducing the probability for replanting or interplanting due to plantation failure, and having an operation which treats the soil without leaving an equipment footprint.

When compared to subsoiling using an unimproved grapple rake, the production of road decommissioning within temporary roads and skid trails was 3.5 times faster using the SGR4.

[4] Field observations made at the Soil Organic Amendment Restoration (SOAR) study at Umpqua NF, North Umpqua Ranger District.

The greatest benefit of the SGR is the project cost savings. Two operations can be done by one piece of equipment for less than the cost of operating the two pieces of equipment previously required.

While both implements bridge similar gaps in forest management practices, each creates its own potential benefit. The SGR spans the previously large gap between treating harvest related fuels and treating harvest related soil impacts. The SEB makes it possible to implement road obliterations as commonly envisioned. Ultimately both implements increase the opportunity for treating legacy compaction and concurrent treatment of new compaction while treating other results (such as fuels) of forest management activities. Other applications of theses implements include wildland fire suppression efforts and its rehabilitation, and BAER work (Burned Area Emergency Rehabilitation).

Through field trials on the Umpqua National Forest, and in practical application, these implements have shown that forest management and restoration projects can attain new levels of proficiency and quality for the land being treated while ensuring the greatest economic benefit.

Using AutoCAD drawings from the Umpqua National Forest, a duplicate of the SGR was built for the Idaho Panhandle NF at a cost of $6,850. An estimated cost for the SEB is $6,000. These costs are presented only as estimates and are not quotes from fabricators.

Product Information

To find out more about the tools discussed in this report, please contact the following Umpqua National Forest employees:

- Jim Archuleta, Diamond Lake RD Soil Scientist by phone at 541–498–2531 or by e-mail at jgarchuleta@fs.fed.us.

- Michael Karr, Forest Road Maintenance Team Leader by phone at 541–498–2531 or by e-mail at mkarr@fs.fed.us.

For information concerning the pricing and availability of the implements contact the companies listed below.

Subsoiling Grapple Rake (SGR)
Pat and Tim Kilkenny
Kilkenny Machine Company
4380 North Umpqua Highway
Roseburg, OR 97470
541–672–5147

Subsoiling Excavator Bucket (SEB)
Dick Ganfield
Shamrock Steel Fabricators Inc.
4125 McDougal Lane
Eugene, OR 97470
541–688–5994

For further information regarding this project or other forest management projects at the USDA Forest Service's San Dimas Technology and Development Center, San Dimas, CA contact Bob Simonson Forest Management Program Leader at 909–599–1267.